

COUNTY OF LOUDOUN
DEPARTMENT OF PLANNING
MEMORANDUM

DATE: July 1, 2009
TO: Loudoun County Planning Commission
FROM: Marchant Schneider, Project Manager
SUBJECT: July 9, 2009 Planning Commission Worksession
ZCPA 2007-0003 – Dulles 28 Centre

BACKGROUND

Public Hearing

The Planning Commission held a public hearing regarding the above-mentioned application on February 19, 2009. No members of the public spoke regarding the application. Planning Commissioners asked questions regarding market demand for office and retail development within the County, proffer commitments to office development, and layout comparisons of approved development versus surface-parked and structure-parked hotel and office use. The Commission voted 6-0-3 (Brodrick, Klancher, Syska absent) to forward the application to a subsequent Planning Commission worksession for further discussion of the outstanding issues identified in the Public Hearing Staff Report.

Development Proposal

Dulles 28 Associates, LLLP (formerly North Dulles Retail Associates LP), and Dulles 28 Hotel One, LLC, have submitted a Zoning Concept Plan Amendment (ZCPA) application to amend the concept plan and proffers approved with ZMAP 1989-0021 and ZCPA 1998-0007, Dulles 28 Centre. The application proposes to amend the mix of uses previously approved to be developed on the Dulles 28 Centre site (west of Pacific Boulevard) to include the option to develop up to 225,000 square feet of hotel use and up to 453,000 square feet of office use with no resulting change in development density. A detailed listing of the revised mix of uses is provided below.

The application also proposes to increase the permitted floor area east of Pacific Boulevard to expand existing hotel use by 20,000 square feet. Approximately 115,000 square feet of hotel use has been developed east of Pacific Boulevard. The increase in floor area is a result of the abandonment of a portion of Commercial Drive right-of-way at its former intersection with Route 28.

The 47.13 acre property is west of Pacific Boulevard and is zoned PD-CH (Planned Development – Commercial Highway). The application is subject to the 1972 Zoning Ordinance and is located within the Route 28 Taxing District.

ZCPA 2007-0003 – Proposed Change to Mix of Uses West of Pacific Boulevard

Type of Use	West of Pacific Boulevard (ZCPA 1998-0007)*	West of Pacific Boulevard (Proposed)*
Anchor Retail	170,000 sq.ft.	170,000 sq.ft.
Inline Retail	150,000 sq.ft.	150,000 sq.ft.
Pad Site	48,000 sq.ft.	48,000 sq.ft.
Office	65,000 sq.ft.	453,000 sq.ft.
Hotel	0	225,000 sq.ft.
Theater	40,000 sq.ft.	40,000 sq.ft.
Maximum Developable Area	453,000 sq. ft. (aggregate)	453,000 sq. ft. (aggregate) (non-office not to exceed 388,000 sq. ft.)

*Auto Dealer and Auto-Related Services Uses are alternatively permitted to develop on the subject property up to 0.4 FAR

APPLICANT REVISIONS

The Applicant has provided the following documents subsequent to the Planning Commission public hearing. The content of these documents is discussed below and copies of the documents are attached for the Commission's reference.

1. Applicant response to outstanding issues dated May 18, 2009 and June 30, 2009
2. Memorandum from Gorove / Slade Associates, subject "Waxpool Road and Pacific Boulevard Signal Improvement", dated June 10, 2009
3. Proffer Statement dated July 3, 2008, revised through June 30, 2009, with Exhibit B - "Dulles 28 Buffer", dated March 13, 2009
4. River and Stream Corridor Overlay District Exhibit dated May 13, 2009
5. Concept Development Plan dated February 13, 2008, revised through May 13, 2009

ISSUE

The Referral Agency Comment Summary in the Planning Commission Public Hearing Staff Report indicated multiple outstanding issues regarding the application's conformance with the Keynote Employment, green infrastructure, and bicycle and pedestrian policies of the Revised General Plan (RGP) as well as Level of Service (LOS) of the road network supporting existing and future development. The status of these issues is outlined below.

Comprehensive Planning

1. *Identify development on Concept Development Plan (CDP) as either Keynote Employment or Destination Retail use.*

Staff recommended property frontage along Waxpool Road be designated for Keynote Employment uses consistent with RGP policies which emphasize the Waxpool Road corridor as a prominent business corridor. The Applicant has revised the Concept Development Plan (CDP) to divide the subject property west of Pacific Boulevard into two Landbays. Office and hotel use is limited to "Landbay A" which fronts Waxpool Road and Pacific Boulevard. The issue is addressed.

2. *Provide commitment to previously permitted office development (65,000 square feet).*

The Applicant has amended the proffer statement (Proffer 2.B) to limit non-office use west of Pacific Boulevard to 388,000 square feet of the permitted 453,000 square feet of development, a difference of 65,000 square feet. The issue is addressed.

3. *Provide catchment area / market study to determine demand and viability of hotel use or otherwise commit to full-service hotel facilities to include meeting space and dining service in support of office use (Keynote Employment).*

The Applicant has amended the proffer statement (Proffer 5) to establish standards requiring hotel use to include 2,000 square feet of dividable meeting space, a restaurant onsite or within Dulles 28 Centre, and amenities such as an exercise room, swimming pool, or ballroom. The issue is addressed.

4. *Commit to site design elements (expand proffered design guidelines to include multi-story office development adjacent to Waxpool Road, parking behind buildings and/or screened, enhanced landscaped screening of office uses).*

The Applicant has revised the proffer statement (Proffer 3) to commit to office structures of a minimum four stories as well as provide alternative landscaping standards where office and/or hotel use is oriented away from Waxpool Road / Pacific Boulevard and toward the existing stormwater management facility and adjacent golf course. Under this scenario, increased understory landscaping along Waxpool Road and Pacific Boulevard will be provided in order to screen parking between the roads and the building (See

Dulles 28 – Buffer, Attachment 2). Further, no more than a single travelway with parking on one side will be permitted between the building and stormwater management facility. Buildings will be constructed with consistent architectural treatment, materials, and colors on all sides. The issue is addressed.

5. *Identify size, location, phasing, and features of public open space and civic use.*

The Plan calls for Keynote Employment centers to provide a minimum of 5% civic space (2.0 acres on the subject property) and 10% open space (4.1 acres on the subject property).

The Applicant has revised the proffer statement (Proffer 6) to include a commitment to provide a pavilion or similar structure to generate pedestrian activity and act as a visual focal point of an office or hotel development. Such “civic space” is to be located adjacent to the stormwater management facility / pond or alternative location agreed to by the Zoning Administrator. The Applicant estimates the amenity with stormwater management facility will comprise 3.14 acres.

With regard to public open space, Staff has recommended designating existing vegetation within fifty feet of the River and Stream Corridor and other undisturbed vegetation on the site as “open space”. The Applicant has identified a Tree Conservation and Reforestation Area encompassing steep slopes located within fifty feet of the River and Stream Corridor; however, the acreage has not been tabulated to determine if the open space policy recommendation has been met. **The issue is not addressed.**

6. *Depict bicycle and pedestrian connections along property frontage to Waxpool Road, Pacific Boulevard, Auto World Circle, internal to project site and development east of Pacific Blvd. Bicycle racks to be provided at all uses.*

An existing four-foot wide trail fronts the subject property along Waxpool Road. The Applicant has revised the proffer statement (Proffer 7) and Concept Development Plan to include commitments to a six-foot wide asphalt trail within a fourteen-foot wide public access easement along Pacific Boulevard. A five-foot wide sidewalk is to be constructed along property's frontage to Auto World Circle. All buildings constructed in Landbay A shall include a bicycle rack. Office buildings within Landbay A shall include a shower facility. A crosswalk and pedestrian signalization is to be provided at intersection of Columbia Drive and Pacific Boulevard.

Staff continues to recommend that a ten-foot wide shared use trail be provided along Pacific Boulevard. This width is consistent with existing trails on the west side of Pacific Boulevard south of the subject site and new construction along Pacific Boulevard between Auto World Circle and W. Severn Way. While an existing four-foot wide sidewalk exists along Pacific Boulevard north of Commercial Drive, this should not preclude the Applicant from providing the recommended improvement. A ten-foot wide shared use path is consistent with the recommendations of the Bicycle and Pedestrian

Mobility Master Plan and CTP which identify both of these roadways as priority bicycle routes. Moreover, such a trail provides a critical regional link to the W&OD Trail. **The issue is not addressed.**

7. *Delineate Green Infrastructure elements on subject property (streams and floodplains, steep slopes, and associated management buffers).*

The Applicant has provided the requested information as an exhibit to the Concept Development Plan (see Attachment 4).

8. *Implement Green Infrastructure policies (conserve wetlands, surface waters, forest resources, steep slopes, habitat).*

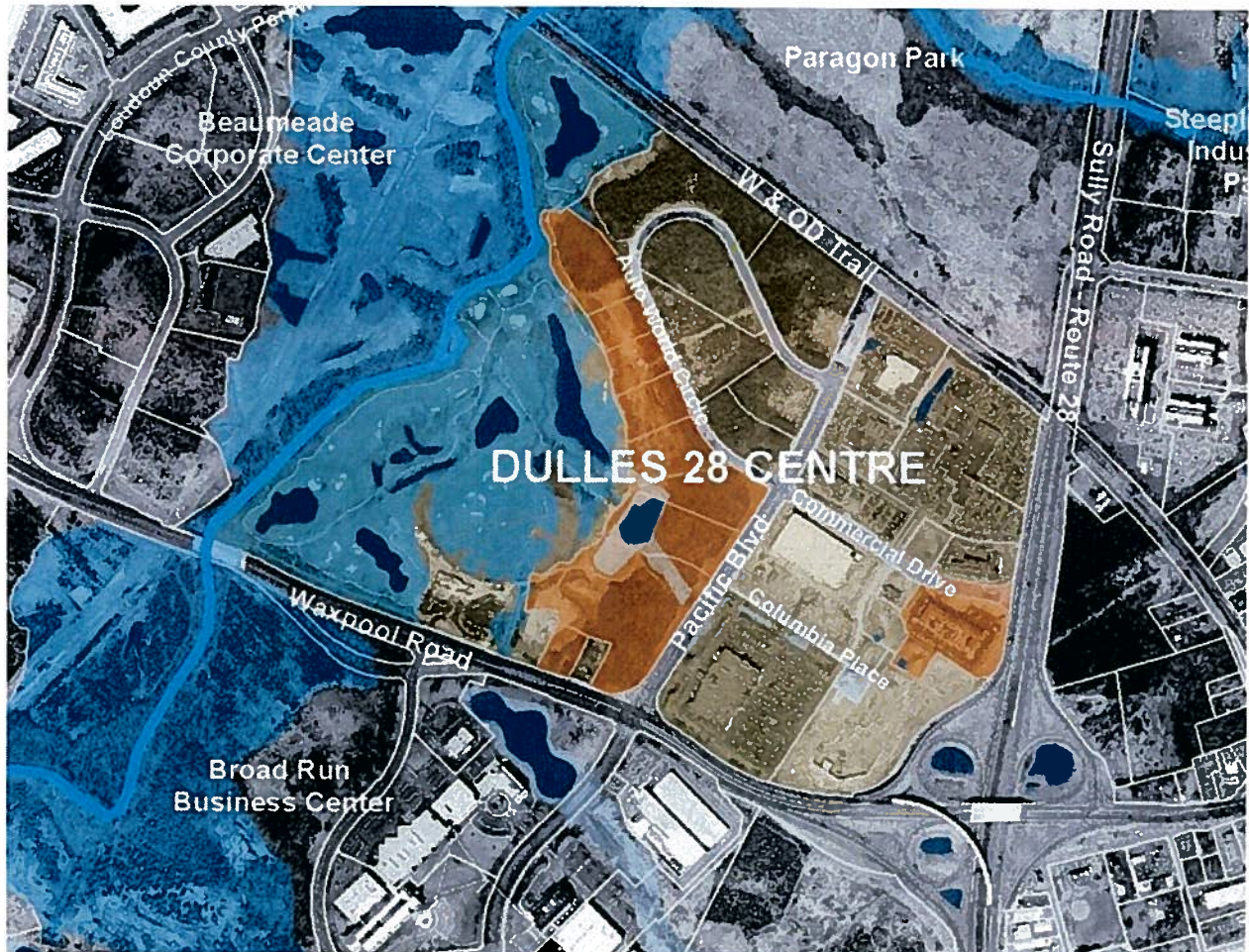
Elements of the countywide Green Infrastructure are found on the subject site, including forest cover and moderately and very steep slopes, natural and man-made drainage ways, wetlands, and minor floodplain associated with the Broad Run. The RGP directs that development should take place around these elements and incorporate them into the design of the site. The Applicant states the RGP recommended fifty-foot management buffer adjacent to the River and Stream Corridor is comprised of steep slopes that have been disturbed by sewer line installation and are largely cut off from the boundaries of an altered floodplain by cart paths on the adjacent golf course. Further, water quality protections are otherwise provided by development conditions associated with approval of the golf course (SPEX 2006-0025, Presidential Golf Club). The Applicant has alternatively agreed to renovate an existing stormwater management facility to either a stormwater retention pond (wet) and/or extended detention facility in order to meet RGP policies regarding water quality protection of the Broad Run. The Applicant has also revised the proffer statement (Proffer 10) and CDP to identify a Tree Conservation and Reforestation Area encompassing steep slopes located within the fifty-foot buffer identified on the River and Stream Corridor Overlay District exhibit referenced above.

Based on the physical constraints of the site and previous land disturbing activities impacting the natural features on the site, Staff has been amenable to exploring other measures to achieve the intent of the River and Stream Corridor policies outlined in the RGP. Staff has recommended that the Applicant explore protecting the jurisdictional waters that feed into the existing stormwater management pond to include existing tree cover surrounding these jurisdictional waters as well as preservation of existing tree cover in the northwest parcel of the subject property. Other options include expanding the Tree Conservation and Reforestation Area to include all steep slopes north of the stormwater management pond and/or open areas adjacent to the floodplain that are not likely to be disturbed during development of the site. **The issue is not addressed.**

9. *Designate existing vegetation on the northern parcel and along jurisdictional waters in southern portion of the subject property as tree conservation areas.*

See staff recommendation at item 8 above.

Minor and Major Floodplains / Water Features



Environmental Review Team

10. Provide commitments to Low Impact Design (LID) / water quality measures for stormwater management.

As noted above, the Applicant has alternatively agreed to renovate an existing stormwater management facility to either a stormwater retention pond (wet) and/or extended detention facility (Proffer 4A). The Applicant has also committed to providing and additional LID strategy with the development of office and/or hotel use (Proffer 4B). The issue is addressed.

11. *Prioritize wetland and stream mitigation.*

The Applicant has revised the proffer statement to prioritize wetland mitigation strategies on the subject site (Proffer 9). The issue is addressed; however, final proffer language continues to be discussed.

Transportation Improvements

12. *Address Waxpool Road / Pacific Boulevard intersection LOS F. A revised traffic study should include the LOS improvements resulting from the Pacific Boulevard Extension Project.*

The Applicants' traffic impact study dated July 2007 demonstrates a Level of Service (LOS) D or better for the majority of roadways anticipated to serve the proposed uses, both under existing conditions and upon development of the requested hotel and office use. It should be noted that daily trip generation is anticipated to decrease with development of the hotel and office use.

The intersection of Waxpool Road and Pacific Boulevard is shown to operate at LOS F under existing conditions and upon build-out. The Countywide Transportation Plan (CTP) specifies a LOS D or better as an acceptable level of service. Office of Transportation Services (OTS) Staff recommended the Applicant's traffic study be revised to adjust the forecasted build out year (later than 2011) and include traffic movements associated with completion of the Pacific Boulevard Extension project north of the subject site.

In response, the Applicant provided a summary of traffic analyses recently provided for proposed development on Pacific Boulevard north of the subject site (*see Attachment 1*); specifically, Kincora (in review) and Paragon Park (approved). Both studies assumed completion of the Nokes / Route 28 Interchange. The Applicant's summary notes that the function of the Waxpool Road / Pacific Boulevard intersection improves with the completion of the Pacific Boulevard Extension project and opening of the Nokes / Route 28 Interchange. However, at the presumed build-out of development along the Pacific Boulevard corridor (2025), LOS will again deteriorate at the Waxpool Road / Pacific Boulevard intersection. Further development of the CTP network, notably Gloucester Parkway, will be necessary. The Applicant states key infrastructure improvements (completion of Pacific Boulevard Extension Project, Nokes Boulevard / Route 28 interchange, and ultimately, Gloucester Parkway) will generally maintain adequate LOS at the Waxpool Road / Pacific Boulevard intersection.

13. *Address existing traffic delay at Waxpool Road / Pacific Boulevard intersection with revised proposal.*

On April 2, 2009, VDOT and County Staff met with the Applicant to discuss existing LOS conditions at the Waxpool Road / Pacific Boulevard intersection and identify future capacity needs. VDOT Staff noted an analysis of multiple intersections along the

Waxpool Road corridor had been commissioned by VDOT. Possible signal phasing and alternative lane configurations noted in the analysis were discussed. The Applicant agreed to fund additional analysis of these potential improvements and solicited a traffic consultant to conduct the analysis. Five scenarios were identified and tested by the traffic consultant. Two scenarios noted LOS improvement (*see Attachment 3*). The analysis has been provided to VDOT for further consideration. OTS staff had recommended right-of-way at the Waxpool Road / Pacific Boulevard be dedicated by the Applicant in anticipation of improvements which may require right-of-way to increase road capacity. However, such dedication will be at the discretion of the Applicant.

NOTE: The County has received additional funds from the American Recovery and Reinvestment Act (federal stimulus money) and OTS has recommended a commitment of \$5.3 million to intersection improvements along Waxpool Road, to include improvements to the Waxpool Road / Pacific Boulevard intersection. Monies from the Commonwealth of Virginia in support of Raytheon's move to the AOL campus will be used to extend Pacific Boulevard between Dresden Street and Relocation Drive (formerly Cedar Green Road).

14. *Delineate site access on the Concept Plan. Access should be compatible to VDOT standards. Right-in, Right-out entrance south of Commercial Drive is not supported.*

Two points of access to the subject site from Pacific Boulevard were approved with previous development plans for Dulles 28 Centre. Due to limited distance between a right-in / right-out entrance and the Waxpool Road / Pacific Boulevard intersection, OTS Staff notes it is unlikely the entrance will meet VDOT requirements. Further, CPAP 1990-0900 identifies a single point of entry at Commercial Drive, but not the right-in / right-out entrance identified on the CDP. Staff has noted that continued inclusion of this entrance does not assure approval from VDOT. The issue addressed.

15. *Construct / provide R.O.W. for 10' multi-purpose trail along property frontage to Pacific Boulevard matching facilities north of Dulles 28 Centre consistent with Bicycle and Pedestrian Mobility Master Plan.*

See staff discussion at item 6 above. **The issue is not addressed.**

16. *Demonstrate proffer compliance to include traffic signalization at Pacific Boulevard / Commercial Drive.*

The Applicant notes the Columbia / Commercial Drive intersection is currently signalized and may preclude an additional signal at the Commercial Drive / Pacific Boulevard intersection due to the short distance between intersections. The Applicant will be required to assess signalization as part of a 527 Study required as part of a site plan review. The issue is addressed.

Proffer Statement

Staff and the Applicant continue to finalize proffer language for the application.

Requested Illustrative

Layout comparisons of approved development versus surface-parked and structure-parked hotel and office use will be provided at the Planning Commission worksession.

STAFF RECOMMEDATION

Staff can support the request to develop office and hotel use on the subject property as the proposed uses are consistent with the Keynote Employment Policies of the RGP. However, it has not been determined that the project meets the green infrastructure, open space, and bicycle / pedestrian policies of the RGP.

DRAFT MOTION(S):

1. I move that the Planning Commission forward ZCPA 2007-0003, Dulles 28 Centre, to a subsequent Planning Commission worksession for further discussion.

OR,

2. I move an alternate motion.

Attachments

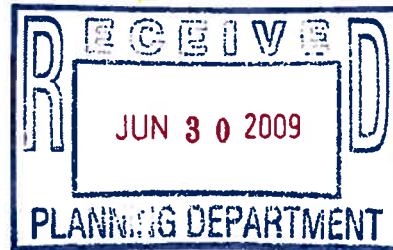
1. Applicant Correspondence dated June 30, 2009, and May 18, 2009.
2. Proffer Statement dated July 3, 2008, revised through June 30, 2009, with Exhibit B - "Dulles 28 Buffer", dated March 13, 2009
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June 30, 2009

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Re: Dulles 28 Centre: ZCPA 2007-0003

Dear Marchant:

Thank you for facilitating our discussions with various staff referral agents to address outstanding issues on this case. This letter serves as a follow up to our submission of materials on May 18 and summarizes additional revisions to the application and reaffirms the intent of this application.

To recap, the sole goal of this proposed Zoning Concept Plan Amendment is to improve the mix of uses permitted on the site; the Applicant is not seeking an increase in the gross square footage already approved. Today, a very limited amount of office use is permitted, with the lion's share of the approved 453,000 square feet being available for in-line retail. We propose that the use mix be revised so that Class A office uses and full service hotel may be permitted.

Office use implements the County's vision for the Route 28 Corridor as an economic engine and offers significant opportunity to reduce traffic impacts. It is difficult to market the Dulles 28 Centre for high quality office and hotel uses at the current time because such use is not allowed. As the County considers how to enhance the value of the Route 28 Corridor for office, the Dulles 28 Centre case offers an easy improvement – ensure that the desired uses are permitted.

Correspondence to you dated May 18, 2009 summarized revisions to date incorporated into the proposal intended to address staff and Planning Commission concerns. Since that time, the following additional responses are offered:

LAND PLAN

- The proffers include a commitment to 4-sided architecture requested by staff as further assurance that any office constructed oriented toward the pond would not "turn its back" on Pacific Boulevard.

- Staff recommended that if a building were oriented internally to the civic uses that will be located in proximity to the pond, that no vehicular circulation be permitted between the pond and the building. While we have committed to limiting circulation in front of the building to a single travelway with parking only on one side of the travelway, we are reluctant to eliminate the possibility of vehicular circulation entirely. First, with no vehicular circulation, it is difficult to ensure that the façade of the building(s) facing the pond would function as the front. Second, handicap parking could be provided to the side of the building, but such a layout may not be optimal and may force buildings, if there are two, to be further apart than is desirable for a pedestrian friendly layout. The buildings at Loudoun Tech, facing a pond adjacent to Route 7, provide an example of how buildings can be well-oriented toward a high quality amenity even if vehicular circulation is provided.
- Enhanced landscaping is provided along Pacific and Waxpool for the office/hotel option in Land Bay A to screen potential parking areas. The landscaping represents an increase from what is required by the zoning ordinance and differs from the previously proffered landscape master plan with a greater focus on the 11' planting zone adjacent to the parking envelope. As stated in our May 18 correspondence, the proposed landscaping more directly addresses the needs of the project. Trees are further apart to ensure survivability and allow for higher canopied trees. Evergreen shrubs are provided along the parking lot as a more effective screen and the trail is incorporated into the design.
- Bicycle and pedestrian needs have been more clearly met. We have committed to providing bike racks to serve all buildings, not just office. Shower facilities will be provided for office users. With regard to the multi-purpose trail, while we continue to propose that a 6' wide trail is more context sensitive than a 10' wide trail, we have agreed to place the trail within a 14'-wide public access easement which will permit easy expansion in the future if the trails/sidewalks on either end are expanded.
- We have improved the protection of the Tree Conservation and Reforestation Area which was added to the CDP. Typically, the County supports impacts to Tree Conservation Areas that are required for stormwater management. Because such features can have significant impacts on forest cover, even as they improve water quality, we have agreed that stormwater management BMPs will not be located in the Tree Conservation Area.
- The proffer committing to mitigation of permitted wetlands impacts has been revised to address staff concerns that mitigation be provided in Loudoun County if possible and if not, within the Potomac River Watershed.
- Stormwater management commitments will ensure that all stormwater flowing from new impervious surface on the subject property will be properly treated in terms of quality and quantity. Again, development of office or hotel, pursuant to this application, will provide a wet pond or extended detention pond consistent with the FSM. The proffers exceed this standard with a commitment to an additional LID strategy to be identified in collaboration with the County.

TRANSPORTATION

As we have noted, applicant's proposal would potentially reduce the traffic generated from the site in relation to the current approved land use by a substantial amount. Office and hotel uses generate far fewer vehicle trips than the approved retail. While staff has acknowledged the value of supporting a less trip intensive land use than is currently approved, OTS has expressed concerns about the function of the intersection of Waxpool and Pacific.

The applicant is also concerned about this intersection and subsequent to the April 2, 2009 meeting with VDOT and OTS, engaged Gorove/Slade to conduct analysis of potential improvements. Five scenarios were identified and tested, with two showing potential for improvement. The study has been provided to VDOT for consideration. The applicant is committed to continuing to work with VDOT to ensure that the road network in this location functions well to serve not only the property subject to this application but also the balance of the Dulles 28 Centre.

In the long run, the addition of key infrastructure improvements – the extension of Pacific Boulevard, the Nokes interchange and, ultimately, Gloucester Parkway – will generally maintain the LOS at Pacific and Waxpool. The completion of the Nokes interchange, which will occur prior to any development of the subject property, will significantly change the network by providing a substantial alternative to the Pacific/Waxpool intersection. The current situation, where all traffic north of Waxpool must use the intersection, is temporary.

We look forward to further discussion at the worksession on July 9. As requested by the Planning Commission, we will provide an illustrative layout of the office and hotel uses at the worksession. We will also provide detail regarding the distribution of vehicle trips from the site as requested. If any additional questions arise that we may assist with addressing, please do not hesitate to let me know.

Very truly yours,

REED SMITH LLP


Ann Eberhart Goode, AICP *ylb*

AEG:jlb

Enclosures

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May 18, 2009

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Re: Dulles 28 Centre: ZCPA 2007-0003

Dear Marchant:

In preparation for a Planning Commission worksession on this case, I have summarized our response to outstanding issues.

COMPREHENSIVE PLANNING

- Identify land use as Keynote or Destination Retail. We have identified "Land Bay A," the most prominent portion of the site for a Class A office or hotel use, and committed to placing either use in this particular land bay. A note has been added to Sheet 4 restating that total square footage of all uses in both Land Bays A and B may not exceed 453,000 sf.
- Commit to a minimum of 65,000 square feet of office, consistent with current program. The proffers have been revised to do so by limiting the permitted amount of non-office use of the site. (Proffer 2.B)
- Commit to full service hotel or provide hotel market study. We have revised the proffers to include a commitment to full service hotel.
- Commit to design elements. The following commitments have been incorporated to ensure that the office/hotel options sought would result in a high quality development consistent with Keynote Employment land use:
 - Increase in minimum number of stories for office use from 3 to 4 stories.
 - Commitment to limiting circulation in front of the building to a single travelway with parking only on one side of the travelway, in the instance where the primary entrance to the building is oriented toward the pond feature.

- Enhanced landscaping along Pacific and Waxpool for the office/hotel option in Land Bay A, to screen potential parking areas. The landscaping represents an increase from what is required by the zoning ordinance and differs from the previously proffered landscape master plan with a greater focus on the 11' planting zone adjacent to the parking envelope.

Zoning Provision	Landscaping Required	Yards Required
Proposed ZCPA	Canopy trees 40' spacing Extensive Shrub planting within first 11' of the buffer yard Redesign to incorporate trail within buffer area, between trees and shrub plantings	25' front yard
Proffered Landscape Master Plan	Canopy trees 25' spacing Shrubs All landscaping shown in first half of yard (12.5' adjacent to the parking area)	25' front yard
PD-CH District; 1972 Zoning Ordinance	None	25' front yard (Sec. 710.11.1.1) no side or rear yards (Sec. 710.11.1.2)

- Identify civic use. An enhanced area for seating has been incorporated into the proffers and CDP so that a pavilion, sufficient in scale to provide shelter for tables and chairs for employees/visitors. This civic area is located in relation to the stormwater management feature and the golf course, constituting a unique civic space. Together these areas comprise 3.14 acres.
- Depict bicycle and pedestrian connections along Waxpool, Auto World Circle and Pacific. All such facilities are shown; bike racks as well as showers for office buildings have been addressed in the proffers.

- Delineate Green Infrastructure elements on subject property. An exhibit has been developed to show the surface water and slope features, as requested, and is included with this correspondence.
- Conserve Green Infrastructure Elements. A Tree Conservation and Reforestation Area has been added to the CDP. In addition, the proffers address wetland mitigation that may be needed on the site, as well as committing to a pond design that will incorporate a wet pond or extended detention design.
- Designate existing vegetation on the north and south as tree conservation area. A *Tree Conservation and Reforestation Area* has been established in the area of steep slopes on the northern portion of the parcel.

ENVIRONMENTAL REVIEW TEAM

- Provide commitments to LID/water quality measures for stormwater management. The proffers have been revised to commit to a wet pond or extended detention pond consistent with the FSM, which addresses LID. The proffers exceed this standard with a commitment to an additional LID strategy to be identified in collaboration with the County (Proffer 4.B).
- Prioritize wetlands and stream mitigation. The proffers include a commitment to prioritization of mitigation within the Broad Run watershed.

TRANSPORTATION

- Waxpool / Pacific Boulevard impacts. The applicant's proposal would reduce the traffic generated from the site in relation to the current approved land use. Notwithstanding, the applicant has met with VDOT and is collaborating on additional research into potential solutions. As a result, the applicant agreed to provide a summary of related traffic studies and to collaborate with VDOT on an effort to determine the most effective potential improvements for the intersection.

Meeting with VDOT to discuss potential improvements to the Waxpool/Pacific intersection.

The applicant, along with County planning and transportation staff, met with the appropriate VDOT staff on April 2, 2009 to discuss existing concerns about the Waxpool/Pacific intersection as well as potential improvements to address future capacity needs in this high intensity location. VDOT reported that an analysis of the Waxpool corridor had been completed to evaluate not only the intersection with Pacific, but functionality in other locations as well. In consultation with the applicant's consulting engineer, potential light timing and lane configuration improvements were identified. The applicant agreed to fund additional analysis of these potential improvements and has already engaged Gorove/Slade to conduct the analysis, which is currently underway.

There are several other important developments that can be expected to result in improvements to the intersection. The County has received additional funds from the American Recovery and Reinvestment Act (federal stimulus funding) and the Office of Transportation Services is recommending a commitment of \$5.3 million to intersection improvements along Waxpool, including to the intersection of Pacific and Waxpool. Additionally, Raytheon's decision to locate in the AOL campus south of Waxpool brings with it a commitment of additional funds to complete Pacific Boulevard to the south of Waxpool, completing another link in the CTP road network in the immediate vicinity.

Summary of Existing Studies.

The traffic study for the Dulles 28 Centre ZCPA assumed a buildout year of 2011 and an analysis of 2020 conditions was not required as most growth was anticipated earlier. As such, the study did not assume the completion of the Nokes Boulevard/Route 28 interchange. To support the Planning Commission's assessment of the impact of the completion of the interchange, the applicant has summarized traffic analyses provided recently for proposed development on Pacific Boulevard, to the north of the subject property – Kincora (in review) and Paragon Park (approved). These two projects are larger than Dulles 28 Centre ZCPA and assume a longer buildout therefore providing a 2020 or 2025 build out scenario. Both studies assumed for future years the completion of the Nokes/28 Interchange.

In general, the function of the Waxpool and Pacific intersection improved with the opening of the interchange, as would be expected. By 2025, with the assumed build out of development along the Pacific Boulevard corridor, the conditions at the Waxpool and Pacific intersection would again deteriorate and further development of the CTP network, notably construction of Gloucester, is needed.

Paragon Park. As part of the Paragon Park project, a Special Exception application to, in part, permit 100% office use in the PD-IP zoning district, a study was conducted by PHR&A (dated April 20, 2007). This study analyzed 4 intersections, Pacific/Waxpool, Route 28/Steeplechase, Route 28/Severn Way, Route 28/Nokes. Table 1 provides a comparison of existing conditions as assessed by the traffic study for the Dulles 28 Centre as well as the traffic analyses of the Kincora and Paragon Park studies. Additionally, the table presents the 2020 full build out assessment.

With regard to Paragon Park, the analysis found that given the current level of development, Waxpool/Pacific intersection is generally operating at LOS D or above except for the southbound movement in the AM Peak period (LOS E) and the northbound movement in the PM Peak period (LOS E). At full build out in 2020, and assuming completion of the interchange, the report indicates that the Paragon Park application was projected to increase delays at the Waxpool/Pacific Boulevard intersection by 16%, and the staff report indicated that overall traffic generated from the site would increase by 24%. Because the Planning Commission and Board agreed that this impact had been mitigated by contributions to the transportation system,

transportation impacts were deemed acceptable, and the application was approved. According to the traffic study, the Waxpool/Pacific intersection, as currently configured, would function at LOS F in 2020, which assumes full build out of Paragon Park and the Nokes/28 interchange.

Kincora. The Kincora rezoning, currently in review, seeks re-designation of the property to the PD-MUB (Planned Development-Mixed Use Business) zoning district with a Special Exception that would support inclusion of a minor league baseball park. A traffic study was completed by Gorove/Slade (October 23, 2008). The Kincora study used 2025 as a build out year, in contrast to the Paragon Park study, which had a build out horizon of 2020. The Kincora study recommends mitigating strategies for the intersection and assumes completion of the Nokes interchanges as well as the Gloucester Parkway connection to the west.

Dulles 28 Centre. The Dulles 28 Centre traffic study shows that the Waxpool/Pacific intersection is operating at acceptable LOS except during the PM Peak hour. At buildout, the intersection is rated with LOS F, though the proposed development reduces delays in the PM Peak by an anticipated 25%. Again, this analysis did not assume construction of the interchange or Gloucester Parkway.

Table 1: Analysis of the Intersection of Waxpool and Pacific

	AM Peak Existing	PM Peak Existing	AM Peak Buildout	PM Peak Buildout
Paragon Park	B	D	D (Interim*) F (2020)	E (Interim*) F (2020)
Kincora	F	E (D- Saturday)	D	F (C- Saturday)
Dulles 28 Centre	D	E	F**	F**

* Interim assumes full build out of Paragon Park and completion of the interchange but at an earlier point in time, 2010. Clearly, Paragon Park will not be complete in 2010, but the study shows that the presence of the interchange is helpful to the Pacific/Waxpool intersection in the medium term.

** Dulles 28 study did not assume completion of the interchange.

In conclusion, studies of the impacts of Kincora and Paragon Park demonstrate that the addition of key infrastructure improvements – Nokes interchange and, ultimately, Gloucester Parkway – will generally maintain the LOS at Pacific and Waxpool, though significant improvements are not projected. The completion of the Nokes interchange, which will occur prior to any development that may occur at Paragon Park or Kincora, will have a beneficial impact, but continued improvements to the CTP network (e.g. completion of Gloucester) are needed over time.

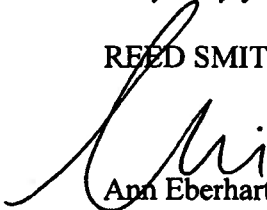
The proposed ZCPA allows for development of the site with office or hotel, both which reduce traffic impacts in comparison to the currently permitted development of the site. This opportunity should be viewed as one of many strategies needed to maintain adequate function of the intersection of Waxpool Road and Pacific Boulevard.

- OTS does not support RI/RO. Potential point of access is retained, though we understand that inclusion in the zoning does not guarantee that it will receive a VDOT permit.
- Construct 10' Multi-Purpose Trail. We are proposing a 6' trail consistent with the facility provided on the south side of Waxpool Road by VDOT.
- Signalization at Pacific and Commercial. As noted in earlier responses, a signal is already included at Columbia and Pacific, so the spacing may be inadequate to install one at Commercial. Nonetheless, the applicant will be required to assess signalization as part of a 527 study required at site plan.

We appreciate your time and look forward to successful resolution of remaining concerns.

Very truly yours,

REED SMITH LLP



Ann Eberhart Goode, AICP

AEG:jlb

Enclosures

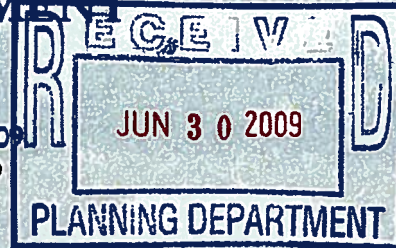
cc: Arthur N. Fuccillo, Esq.
Benjamin F. Tompkins, Esq.

DULLES 28 CENTRE

Zoning Concept Plan Amendment
(ZCPA 2007-0003)

PROFFER STATEMENT

July 3, 2008
Revised January 14, 2009
Revised May 18, 2009
June 30, 2009



Pursuant to Section 15.2-2303(A) of the Code of Virginia (1950, as amended), Dulles 28 Associates LLLP, successor by name change to North Dulles Retail Associates Limited Partnership and Dulles 28 Hotel One, LLC, the applicants and owners herein (hereinafter collectively "Applicant"), hereby proffers that the development of the parcels under consideration, and shown as Tax Map 80((18)), parcels 8 through 15, 25 and 34 (hereinafter "Property"), will be in accordance with the following amended proffers if, and only if, the Zoning Concept Plan Amendment (ZCPA 2007-0003) is approved by the Board of Supervisors of Loudoun County. In the event the said application is denied, these amended proffers shall immediately be null and void and of no further force or effect.

The proffers for ZMAP 1988-0014 and ZMAP 1989-0021 (collectively, the "1989 Proffers"), ZCPA 1997-0002 (the "1997 Proffers"), ZCPA 1998-0007 (the "1998 Proffers"), ZCPA 1999-0007 (the "1999 Proffers") and ZCPA 2006-0010 (the "2006 Proffers") shall remain in full force and effect for the Property, except as specifically amended or supplemented in this proffer statement. The amended or supplemental proffers contained herein shall apply only to the striped and crosshatched portions of Dulles 28 Centre, as depicted on the Concept Development Plan dated February 13, 2007 revised through May 13, 2009, prepared by christopher consultants, ltd.

The Applicant and its successors and assigns voluntarily proffers as follows:

1. Concept Development Plan

The Applicant shall develop the Property substantially in accord with the Concept Development Plan (hereinafter the "Plan") drawn by christopher consultants, ltd. dated February 13, 2007, and revised through May 13, 2009, submitted with the application and attached as Exhibit A hereto. The Plan sets forth (i) the land uses (e.g., office, hotel, retail, commercial, auto dealers and auto related services, commercial recreation and golf related uses, including club house facilities) in the portion of the Property designated as the "West of Pacific Boulevard Land Bay", and (ii) the additional hotel

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square footage permitted in the portion of the Property located in the land bay south of Commercial Drive and east of Pacific Boulevard.

[Note 1: The Concept Development Plan referenced herein replaces the Concept Development Plan referenced in Proffer number 1 of the 1989 Proffers, 1997 Proffers, 1998 Proffers, 1999 Proffers and 2006 Proffers as to the land area west of Pacific Boulevard and included within the Property, i.e., Tax Map 80((18)), Parcels 8, 9, 10, 11, 12, 13, 14, 15 and 25 and cross hatched on the Concept Development Plan.

Note 2: The Concept Development Plan referenced herein supplements the Concept Development Plan referenced in Proffer No. 1 of the 1989 Proffers as to the land area south of Commercial Drive and east of Pacific Boulevard and included within the Property, which is improved with the existing hotel use and cross hatched on the Concept Development Plan, i.e., Tax Map 80, Parcel 34 (the "Existing Hotel Parcel").]

2. Allowable Uses and Square Footage Amounts

- A. The intent of this Zoning Concept Plan Amendment ("ZCPA") is to maintain the same allowable square footage amounts and same allowable mix of uses permitted under ZMAP 1988-0014, ZMAP 1989-0021, ZCPA 1998-0007, ZMAP 1999-0007 and ZCPA 2006-0010 with (i) an increase in the amount of office square footage and the addition of hotel square footage that is permitted within the 453,000 square feet of uses permitted west of Pacific Boulevard pursuant to ZCPA 1998-0007 and (ii) the addition of 20,000 square feet of hotel uses to the square footage approved with ZMAP 1989-0021 for the Hotel Parcel.
- B. The land use and square footage tabulation chart in Proffer 2.c. of the 1999 Proffers is hereby deleted and replaced with the following:

Anchor, Jr. Department Stores	170,000 sq. ft.
Inline Retail, Restaurants, Service and Specialty Stores	150,000 sq. ft.
Pad Sites: Restaurants, Banks Gas Stations, Etc.	48,000 sq. ft.
Offices	453,000 sq. ft.
Hotel	225,000 sq. ft.
Theatres	<u>40,000 sq. ft.</u>

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Notwithstanding that the sum of these uses exceeds 453,000, the total square footage of any combination of these uses that may be developed on the west of Pacific Boulevard land bay may not exceed 453,000. In order to provide for a minimum of 65,000 square feet of office, the total of non-office uses allowed per this Proffer 2.B shall not exceed 388,000 square feet.

[Note 1: As allowed per Proffer 2.c. of the 1999 Proffers, the balance of the 473,000 square feet of retail and commercial uses previously permitted in the area north of Commercial Drive and east of Pacific Boulevard, i.e., 20,000 square feet, remains permitted in such northeastern land bay.

Note 2: As allowed per Proffer 1 of the 1989 Proffers, transfers of square footage between the northern and southern retail/commercial bays on the east side of Pacific Boulevard (including transfers affecting the northeastern land bay commercial and retail square footage that is now also permitted to be developed in the west of Pacific Boulevard land bay) will be permitted within the individual categories (i.e., anchor, inline retail, commercial office, etc.) so long as the total aggregate square footage of a particular category is not exceeded.

Note 3: This paragraph does not impact the amount of total auto dealer and auto related service uses which remain permitted on up to 81.68 acres at up to a .4 FAR, and does not impact the 100,000 square feet of golf and golf related commercial recreation uses permitted in the land area west of Pacific Boulevard that is part of the Property.]

3. Design Guidelines.

- A. The Design Guidelines set forth in Proffer No. 3 of ZCPA 1998-0007 with respect to Unified Architectural Style, Building Materials, Signage, Advertising, Lighting, Landscape Plan, Screening, Circulation, Pedestrian Access, Parking and Loading, and Useable Outdoor Spaces are reaffirmed.
- B. Any office buildings constructed on the west of Pacific Boulevard land bay shall be a minimum of four (4) stories.
- C. The office and hotel uses will be restricted to Land Bay A, provided once the Applicant has constructed either (i) a minimum 4 story office or (ii) a hotel within Land Bay A, it shall be permitted to develop the balance of the office and hotel square footage on the remainder of the Property.
- D. If a hotel or office use is developed in Land Bay A and there is to be parking between the building and Pacific Boulevard and/or Waxpool Road, the Applicant shall install the landscaping consistent with the standard established by the landscape

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plan attached as Exhibit B hereto along the road frontage adjacent to said office or hotel in lieu of the landscaping referenced in Proffer 3.A. hereof. Additionally, if a hotel or office use is developed in Land Bay A, and the building is to be primarily oriented toward the storm water management facility, then there shall be no more than a single travelway with parking on one side between the building and such facility. Additionally, any office use in Land Bay A that is primarily oriented toward the stormwater management facility shall be constructed with consistent architectural treatment, materials and colors on all four (4) sides.

4. Stormwater Management Facility/Low Impact Design.

- A. Prior to the first to occur of the issuance of an occupancy permit for either the office or hotel use west of Pacific Boulevard, the Applicant will either renovate the existing stormwater management facility to provide a Retention Pond (wet pond) or an enhanced extended detention facility with sediment forebays in accordance with Chapter 5 of the provisions of the Facilities Standard Manual applicable at the time of zoning. This facility, in combination with wetland plantings, such as an aquatic bench, will be designed to increase the removal of pollutants (specifically phosphorus) and sedimentation from the stormwater run-off associated with the development of the Property beyond what the existing dry pond currently provides. The Retention Pond or enhanced extended detention facility shall provide BMPs for the new development on the Property located west of the Pacific Boulevard that drains to such pond.
- B. In connection with any site plan for either hotel or office use in Land Bay A, the Applicant shall work with the County to implement at least one Low Impact Development (LID) measure deemed likely to be effective based on the physical characteristics of the site. Such LID measure shall be in addition to the commitments in Proffers 4.A and 10.

5. Hotel Use Standards.

The following standards shall apply to any hotel use established on the Property west of Pacific Boulevard:

- A. The Hotel use shall be limited to a maximum of 350 rooms all of which shall be internally accessed only.
- B. The Hotel use shall include a minimum of 2,000 square feet of dividable meeting space.
- C. The Hotel use shall include a restaurant (open to the public) and be a minimum of 1,000 square feet unless there shall exist elsewhere in (i) the land bay South of

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Commercial Drive and East of Pacific Boulevard or (ii) on the Property, a restaurant of at least 4,000 square feet.

- D. The Hotel use shall include at least one of, but shall not be limited to, the following amenities or services:
- i. Exercise room with workout equipment;
 - ii. Guest store or sales area(s) offering personal necessities and other items for sale.
 - iii. Swimming pool
 - iv. Ballroom, in addition to meeting space identified in Proffer 5.B above.

6. Civic Space Design.

Prior to the first to occur of the issuance of an occupancy permit for either the office or hotel use on the Property west of Pacific Boulevard, the applicant shall install adjacent to either the stormwater management facility or the pond feature contemplated in Paragraph 4 of these Proffers, adjacent to the golf course, or at such other location as may be agreed to by the Zoning Administrator, a pavilion or similar structure and pedestrian trails designed to generate pedestrian activity and act as a visual focal point. The pavilion or similar structure will include other amenities such as tables, chairs or hardscape such that users could gather and eat outdoors.

7. Pedestrian Networks/Bicycle and Shower Facilities

- A. Applicant shall construct a six (6) foot asphalt trail, within a fourteen (14) foot wide public access easement, along the Property's frontage on Pacific Boulevard on a site plan by site plan basis, which trail shall be constructed prior to the issuance of the first occupancy permit for the building shown on such site plan.
- B. Applicant shall construct a 5-foot concrete sidewalk along the Property's frontage on Auto World Circle on a site plan by site plan basis, which sidewalk shall be constructed prior to the issuance of the first occupancy permit for the building shown on such site plan.
- C. Prior to the first to occur of the issuance of an occupancy permit for either the office or hotel use on the Property west of Pacific Boulevard, the applicant shall construct a crosswalk across Pacific Boulevard at its intersection with Columbia Drive, including modifying the traffic signal at such intersection to include pedestrian signalization.
- D. All buildings constructed in Land Bay A shall include at least one bicycle rack. Any office building(s) constructed in Land Bay A shall also include shower facilities.

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8. Accoustical Treatment

The hotel use, if constructed, shall be constructed to achieve a maximum interior noise level of 45 dBA. Documentation demonstrating an interior noise level not exceeding 45 dBA, certified by a licensed accoustical engineer, shall be provided to the County prior to, or in conjunction with, approval of the first zoning permit for the hotel use.

9. Wetlands Mitigation

The Applicant shall make a good faith effort to mitigate the wetland impacts associated with the development of the Property in the following order of priority: (i) within the Broad Run Watershed Area within the same Loudoun County geographic Planning Policy Area, (ii) within the Broad Run Watershed Area within another Loudoun County geographic Planning Policy Area, (iii) elsewhere within Loudoun County, or (iv) elsewhere within the Potomac River Watershed. The Applicant shall consider availability of mitigation opportunities in such order of priority but shall not be required to pay more than 110% of the costs of mitigating its wetlands impacts elsewhere within the Potomac River Watershed to mitigate its wetlands impacts within Loudoun County pursuant to items (i), (ii) and (iii) above. Notwithstanding the above, this prioritization shall be determined during the wetland permitting process and be subject to approval by the U.S. Army Corps of Engineers (COE) and the Virginia Department of Environmental Quality (DEQ).

10. Tree Conservation and Reforestation Area.

The Applicant shall establish tree save and reforestation areas in the locations shown on the CDP as the "Tree Conservation and Reforestation Area." Clearing in these areas shall be permitted as allowed by the County and shall be permitted for the construction or maintenance of utilities and trail crossings, and any such clearing shall be limited to the minimum area required for such construction.

A minimum of eighty percent (80%) of the canopy within the cumulative Tree Conservation and Reforestation Area depicted on the CDP will remain in its natural state. In the event that the eighty percent (80%) canopy threshold cannot be achieved within the designated Tree Conservation and Reforestation Area, such lost canopy will be recaptured elsewhere on the Property in locations to be designated at the discretion of the Applicant in consultation with the County. Boundaries of the Tree Conservation and Reforestation Area shall be delineated on the record plat recorded for the development. Construction plans shall clearly define the limits of the Tree Conservation and Reforestation Area and all such

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areas shall be clearly marked in the field. Tree protection fencing shall be placed outside the drip lines along the Tree Conservation and Reforestation Area prior to commencing land-disturbing activities. The Applicant reserves the right to remove, in consultation with the County, any dead, damaged, dying or diseased trees and vegetation, and any tree or vegetation that interferes with the construction, proper functioning and/or use of any utility or drainage easement, or creates a danger to property or persons.

If, during construction on the Property, it is determined by the Applicants' certified arborist and the County Urban Forester that any otherwise healthy tree located within the boundaries of any of the Tree Conservation and Reforestation Area described in this Proffer (and outside of the areas where clearing is permitted) has been damaged by the Applicant during construction and as a direct consequence of the Applicant's development activity will not survive, then the Applicant shall remove each such tree and replace each such tree with two (2) inch caliper native, non -invasive deciduous trees. The species and placement of replacement trees shall be proximate to the area of each such damaged tree so removed, or in another area determined in consultation between the Applicant and the County Urban Forester.

Removal of trees after construction has been completed is prohibited without specific permission of the County Urban Forester except as necessary to accommodate forest management techniques, performed by or recommended by a professional forester or certified arborist, that are necessary to protect or enhance the viability of the canopy. Such management techniques may include, without limitation, pruning and the removal of vines, invasive species, trees uprooted or damaged by extreme weather conditions, and trees or limbs that are diseased, insect-infested, dead, or are considered a hazard to life or property.

In consultation with the Urban Forester, the Applicant will, on a lot by lot basis as development occurs, install additional 1 and 1/2 inch caliper trees such that there are a minimum of 100 trees per acre to enhance the tree canopy and the environmental integrity of the slopes within the Tree Conservation and Reforestation Area.

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These proffers shall be binding on the heirs, executors, administrators, assigns, and successors in interest of the Applicant. The undersigned hereby warrants that all of the owners of legal interest in the subject Property have signed this proffer statement, that he/she has full authority to bind the Property to these conditions and that the proffers are entered into voluntarily.

DULLES 28 ASSOCIATES LLLP

By: **LERNER ENTERPRISES LLC**
its sole General Partner

By: _____
Name: _____
Title: _____

STATE OF _____

COUNTY OF _____, to wit:

I, the undersigned, a Notary Public in and for the State and County aforesaid, do hereby certify that _____, as _____ of Lerner Enterprises LLC, as General Partner on behalf of Dulles 28 Associates LLLP, whose name is signed to the foregoing Proffer Statement, has acknowledged the same before me in my State and County aforesaid.

GIVEN under my hand this ____ day of _____, 2009.

Notary Public

My Commission Expires: _____

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DULLES 28 HOTEL ONE, LLC

By: LERNER ENTERPRISES LLC
its sole General Partner

By: _____
Name: _____
Title: _____

STATE OF _____

COUNTY OF _____, to wit:

I, the undersigned, a Notary Public in and for the State and County aforesaid, do hereby certify that _____, as _____ of Lerner Enterprises LLC, as General Partner on behalf of Dulles 28 Hotel One, LLC, whose name is signed to the foregoing Proffer Statement, has acknowledged the same before me in my State and County aforesaid.

GIVEN under my hand this ____ day of _____, 2009.

Notary Public

My Commission Expires: _____



MEMORANDUM

TO: Gary Christensen Lerner
Ben Tompkins Reed Smith
Anne Goode Reed Smith

FROM: Christopher Tacinelli, P.E.
Tushar Awar, P.E.
Pooja Bhagia

DATE: June 10, 2009

SUBJECT: Waxpool Road and Pacific Boulevard Signal Improvement

INTRODUCTION

This memorandum evaluates geometric modifications to the intersection of Waxpool Road and Pacific Boulevard in Loudoun County, VA. The alternatives are based as a result of a meeting held with VDOT and Loudoun County Planning and Transportation staff on April 2, 2009 to discuss the existing concerns about the intersection of Waxpool Road and Pacific Boulevard as well as the potential improvements to address future capacity needs at this location.

In response to the meeting, three alternatives were evaluated and were requested to be analyzed in order to evaluate geometric and signal phasing modifications. The alternatives requested were as follows:

- *The northbound and southbound left turn movements along Waxpool Road proceed simultaneously for all the alternatives*

➤ **Requested Alternatives:**

- 1) All other movements at intersection remain the same.
- 2) Remove the southbound slip ramp and dedicate separate lane for right turning vehicles allowing 'right turn on red;' in summary the southbound configuration is two left turn lanes, one through lane and one right turn lane
- 3) Remove the southbound slip ramp and dedicate separate lanes for right turning vehicles allowing 'right turn on red;' in summary the southbound configuration is two left turn lanes, one through/right lane and one right turn lane

After technically reviewing the requested alternatives listed above, the intersection of Waxpool Road and Pacific Boulevard resulted in levels of service worse than the existing conditions for the three alternatives.

This memorandum has taken elements from all of the alternatives and developed new alternatives that improve the operations at the intersection.

The proposed alternatives are as follows:

➤ **Proposed Alternative I:**

- 1) Add second southbound right turn lane (dual rights for southbound direction), restripe through lane to through-left turn lane; in summary this would change the existing southbound lane configuration to two right turn lanes, one through-left lane, and two left turn lanes.

➤ **Proposed Alternative II:**

- 1) Convert southbound right turn lane to a free flow lane (remove yield sign).
- 2) Restripe southbound shared through-left turn lane to exclusive left turn lane only and restripe southbound through lane to shared through-left turn lane. This would change the existing southbound lane configuration to dual lefts, a shared through-left and a free flow right turn lane.
- 3) Restripe westbound shared through-right turn lane to exclusive right turn lane only. This would change the existing westbound lane configuration to dual lefts, three through lanes and a free flow right turn lane.

METHODOLOGY

Weekday morning and afternoon peak hour traffic counts were collected on December 17th and 18th, 2008 at the study intersection. These counts are included in the Technical Appendix. The latest Synchro files for the study intersections were obtained from VDOT.

Intersection capacity and queuing analyses were performed at the study intersection for the existing conditions and the above mentioned alternative during the weekday morning and afternoon peak hours using Synchro, version 7.0. The following measures of effectiveness (MOE) were considered in this traffic evaluation during weekday morning and afternoon peak hours:

1. Total delay for each lane group expressed in terms of level of service (LOS), delay (seconds per vehicle); and
2. 95th percentile and average queue for each lane group expressed in terms of feet.

The capacity analysis (movement delay results) comparison for existing conditions and proposed alternative are shown in Table 1 on the following page.

Existing Conditions

This alternative includes maintaining the existing lane configuration and signal phasing at the intersection of Waxpool Road and Pacific Boulevard. The north-south movements are split phased in the existing conditions. The westbound approach has dual left turn lanes, three through lanes and a shared through-right turn lane. The southbound approach has a left turn, a shared through-left, a through lane and a ramp

for right turns in the existing conditions.

Requested Alternatives

The requested alternatives propose that (in all three cases) the northbound and southbound left turn lanes would proceed simultaneously. The first (of three) alternative assumes that all other movements at the intersection remain the same. The second alternative assumes the removal of the southbound slip ramp, dedication of a separate right turn lane allowing for 'right turn on red;' the lane configuration will be two left turn lanes, one through lane, and one right turn lane. The third alternative assumes the removal of the southbound slip ramp, dedication of a separate right turn lane allowing for 'right turn on red;' the lane configuration will be two left turn lanes, one through/right lane, and one right turn lane.

The following table shows the results of the requested alternative:

Link/Turn Bay Length	AM Peak Hour				PM Peak Hour			
	Queue Lengths (feet)				Queue Lengths (feet)			
	50 th	95 th	LOS	Delay (sec)	50 th	95 th	LOS	Delay (sec)
<u>Existing</u>								
Overall Intersection			C	23.7			F	85.3
Eastbound Left	430	121	m124	F 107.2	180	#270	F	120.5
Eastbound Through		828	1136	B 11.0	335	347	B	16.5
Eastbound Right	410	6	m11	A 2.3	0	m1	A	8.7
Westbound Left	1000	179	193	E 79.6	48	80	F	95.2
Westbound Through		200	212	B 12.1	1029	1048	D	37.9
Northbound Left	330	5	20	F 84.5	309	#454	F	102.9
Northbound Through		21	52	F 85.3	244	320	F	88.3
Northbound Right	520	18	52	E 61.5	348	475	F	83.8
Southbound Left	400	119	195	F 88.3	~474	#697	F	270.1
Southbound Through		103	148	F 82.9	232	#309	F	104.0
Southbound Right	880	87	135	E 66.5	~1004	#1260	F	479.8
<u>Requested Option I</u>								
Overall Intersection			C	27.3			E	76.3
Eastbound Left	430	118	m124	F 106.5	180	#271	F	120.7
Eastbound Through		1008	#1191	B 16.8	291	311	B	15.0
Eastbound Right	410	7	m11	A 3.0	1	m1	A	6.7
Westbound Left	1000	208	258	F 80.6	48	80	F	94.9
Westbound Through		239	278	B 15.8	1028	1047	D	38.8
Northbound Left	330	3	11	F 90.1	166	214	F	91.9
Northbound Through		60	112	F 80.2	~563	#794	F 218.6	
Northbound Right	520	34	72	D 54.1	404	#550	F	88.7
Southbound Left	400	112	157	F 84.0	~428	#555	F	222.0
Southbound Through		71	133	E 69.5	77	134	E	75.7
Southbound Right	880	85	149	E 55.3	~1045	#1355	F	265.3

	Link/Turn Bay Length	AM Peak Hour				PM Peak Hour			
		Queue Lengths (feet)		LOS	Delay (sec)	Queue Lengths (feet)		LOS	Delay (sec)
		50 th	95 th						
<u>Requested Option II</u>									
Overall Intersection				C	27.3			E	74.9
Eastbound Left	430	118	m124	F	106.5	180	#271	F	120.7
Eastbound Through		1008	#1191	B	16.8	291	311	B	15.0
Eastbound Right	410	7	m11	A	3.0	1	m1	A	6.7
Westbound Left	1000	208	258	F	80.6	48	80	F	94.9
Westbound Through		239	278	B	15.8	1028	1047	D	38.8
Northbound Left	330	3	11	F	90.1	166	214	F	91.9
Northbound Through		60	112	F	80.2	~563	#794	F	218.6
Northbound Right	520	34	72	D	54.1	404	#550	F	88.7
Southbound Left	400	112	157	F	84.0	~428	#555	F	222.0
Southbound Through		71	133	E	69.5	77	134	E	75.7
Southbound Right	880	0	51	D	53.0	~997	#1310	F	246.8
<u>Requested Option III</u>									
Overall Intersection				E	59.4			F	111.7
Eastbound Left	430	157	169	F	84.7	~227	#310	F	174.7
Eastbound Through		~1535	#1655	F	76.7	348	408	C	20.4
Eastbound Right	410	23	44	B	17.9	1	3	B	17.2
Westbound Left	1000	247	276	E	79.7	139	73	F	120.1
Westbound Through		313	319	B	18.4	~1625	1286	E	66.3
Northbound Left	330	6	10	F	89.0	194	229	F	90.7
Northbound Through		94	86	F	83.5	~798	#997	F	346.6
Northbound Right	520	64	90	D	53.0	~545	#630	F	127.8
Southbound Left	400	175	164	F	95.7	~536	#635	F	300.1
Southbound Through		135	189	E	73.4	~878	#843	F	442.9
Southbound Right	880	0	16	D	52.0	~609	#773	F	153.0

Note:

 DETERIORATED  IMPROVED

As may be seen from the above table, alternatives one through three offer worse results in terms of queuing and levels of service than the existing conditions.

Figures one through four show the lane configurations for the existing and requested alternatives.

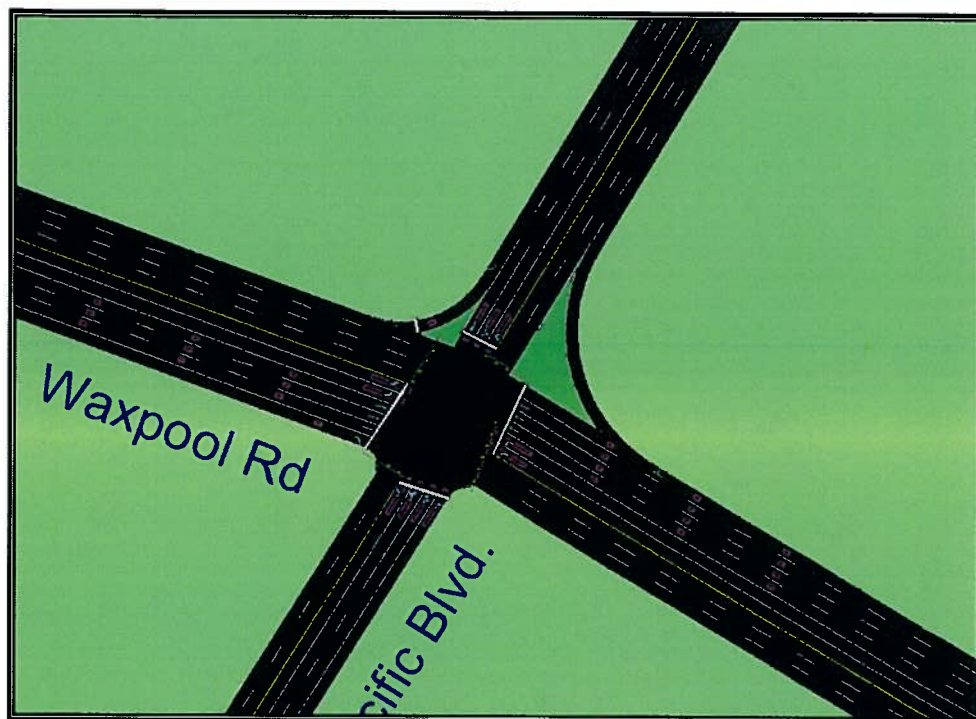


Figure 1: Existing Lane Configuration

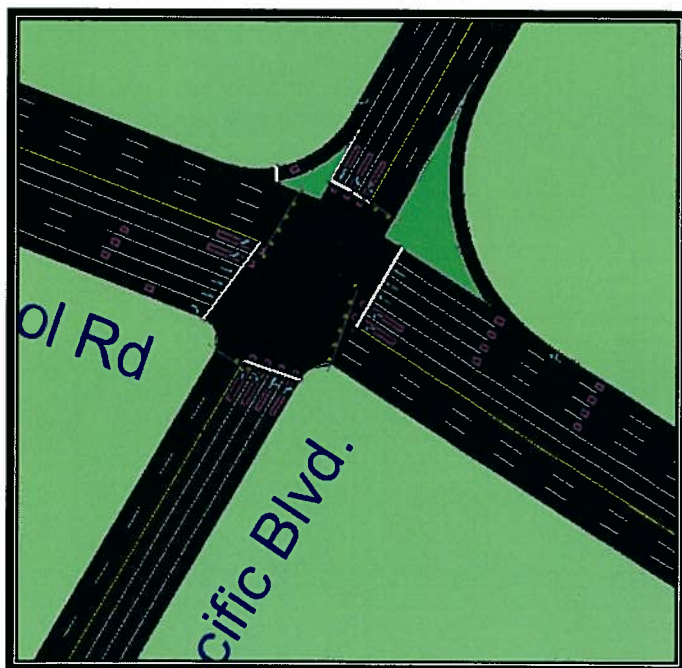


Figure 2: Requested Alternative I

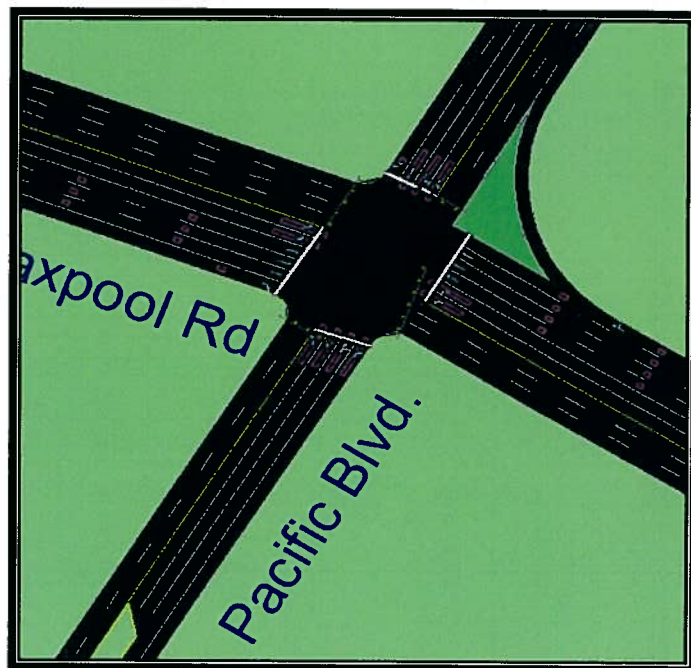


Figure 3: Requested Alternative II

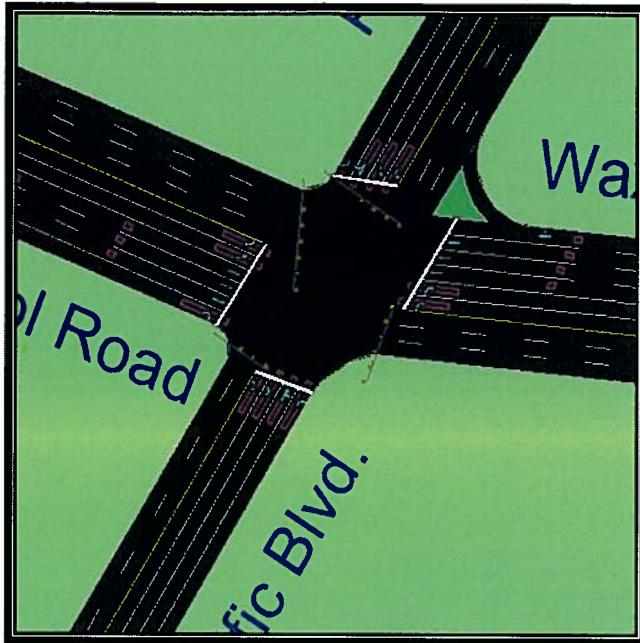


Figure 4: Requested Alternative III

Proposed Alternatives

As mentioned earlier, two proposed alternatives were also analyzed. The two alternatives are listed below:

➤ **Proposed Alternative I:**

- 1) Add second southbound right turn lane (dual rights for southbound direction), restripe through lane to through-left turn lane; in summary this would change the existing southbound lane configuration to two right turn lanes, one through-left lane, and two left turn lanes.

➤ **Proposed Alternative II:**

- 1) Convert southbound right turn lane to a free flow lane (remove yield sign).
- 2) Restripe southbound shared through-left turn lane to exclusive left turn lane only and restripe southbound through lane to shared through-left turn lane. This would change the existing southbound lane configuration to dual lefts, a shared through-left and a free flow right turn lane.
- 3) Restripe westbound shared through-right turn lane to exclusive right turn lane only. This would change the existing westbound lane configuration to dual lefts, three through lanes and a free flow right turn lane.

The lane configuration for the proposed alternatives are shown in Figure 5 and 6 on the next page.

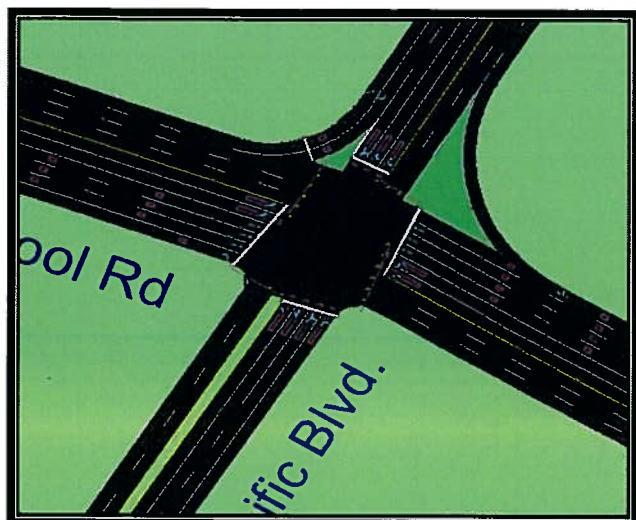


Figure 5: Proposed Alternative I

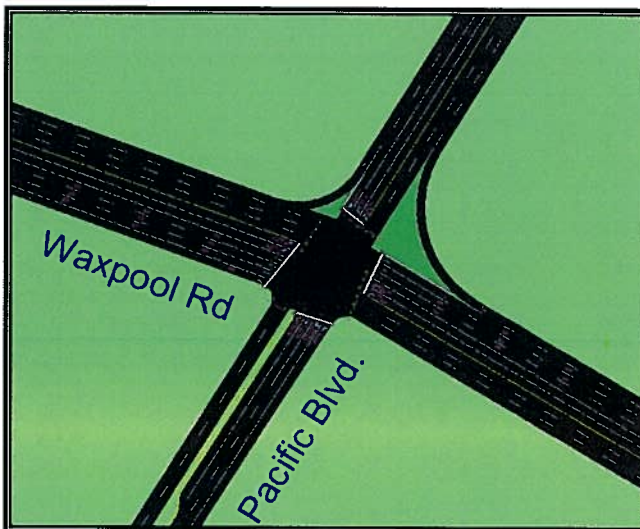


Figure 6: Proposed Alternative II

The following table shows the results of the proposed alternatives.

Table 1A: Capacity Analysis Comparison (Existing and Proposed Alternative I)

	Link/ Turn Bay Length	Existing				Proposed Alternative I			
		Queue Lengths (feet)		LOS	Delay (sec)	Queue Lengths (feet)		LOS	Delay (sec)
		50 th	95 th			50 th	95 th		
<i>AM Peak Hour</i>									
Overall Intersection				C	23.7			C	23.5
Eastbound Left	430	121	m124	F	107.2	122	m124	F	107.3
Eastbound Through		828	1136	B	11.0	763	1136	B	10.8
Eastbound Right	410	6	m11	A	2.3	5	m11	A	2.2
Westbound Left	1000	179	193	E	79.6	179	193	E	79.6
Westbound Through		200	212	B	12.1	196	212	B	12.0
Westbound Right	655		N/A				N/A		
Northbound Left	330	5	20	F	84.5	5	20	F	84.5
Northbound Through		21	52	F	85.3	21	52	F	85.3
Northbound Right	520	18	52	E	61.5	18	52	E	61.5
Southbound Left	400	119	195	F	88.3	108	154	F	84.0
Southbound Through		103	148	F	82.9	112	184	F	85.2
Southbound Right	880	87	135	E	66.5	48	73	E	64.8
<i>PM Peak Hour</i>									
Overall Intersection				F	85.3			E	56.6
Eastbound Left	430	180	#271	F	120.5	180	#270	F	120.5
Eastbound Through		335	311	B	16.5	335	347	B	16.5
Eastbound Right	410	0	m1	A	8.7	0	m1	A	8.7
Westbound Left	1000	48	80	F	95.2	48	80	F	95.2

	Link/ Turn Bay Length	Existing				Proposed Alternative I			
		Queue Lengths (feet)		LOS	Delay (sec)	Queue Lengths (feet)		LOS	Delay (sec)
		50 th	95 th			50 th	95 th		
Westbound Through		1029	1047	D	37.9	1029	1048	D	37.9
Westbound Right	655		N/A				N/A		
Northbound Left	330	309	#454	F	102.9	309	#454	F	102.9
Northbound Through		244	320	F	88.3	244	320	F	88.3
Northbound Right	520	348	475	F	83.8	348	475	F	83.8
Southbound Left	400	~474	#697	F	270.1	282	#412	F	137.4
Southbound Through		232	#309	F	104.0	286	#491	F	153.2
Southbound Right	880	~1004	#1260	F	479.8	~377	#447	F	137.3

Note:

 DETERIORATED IMPROVED

Table 1B: Capacity Analysis Comparison (Existing and Proposed Alternative II)

	Link/ Turn Bay Length	Existing				Proposed Alternative II			
		Queue Lengths (feet)		LOS	Delay (sec)	Queue Lengths (feet)		LOS	Delay (sec)
		50 th	95 th			50 th	95 th		
<u>AM Peak Hour</u>									
Overall Intersection				C	23.7			C	22.6
Eastbound Left	430	121	m124	F	107.2	120	m124	F	106.8
Eastbound Through		828	1136	B	11.0	889	#1191	B	12.0
Eastbound Right	410	6	m11	A	2.3	6	m11	A	2.5
Westbound Left	1000	179	193	E	79.6	179	193	F	79.6
Westbound Through		200	212	B	12.1	221	238	B	12.7
Westbound Right	655		N/A			0	0	A	0.2
Northbound Left	330	5	20	F	84.5	5	20	F	83.5
Northbound Through		21	52	F	85.3	42	73	F	85.3
Northbound Right	520	18	52	E	61.5	15	43	E	60.7
Southbound Left	400	119	195	F	88.3	108	154	F	84.0
Southbound Through		103	148	F	82.9	112	184	F	85.2
Southbound Right	880	87	135	E	66.5	0	0	A	0.1

PM Peak Hour

Overall Intersection				F	85.3			D	50.0
Eastbound Left	430	180	#271	F	120.5	180	#270	F	119.4
Eastbound Through		335	311	B	16.5	334	342	B	16.3
Eastbound Right	410	0	m1	A	8.7	0	m1	A	8.6
Westbound Left	1000	48	80	F	95.2	48	80	F	94.1
Westbound Through		1029	1047	D	37.9	1291	1337	D	44.8
Westbound Right	655		N/A			0	0	A	0.3
Northbound Left	330	309	#454	F	102.9	309	#454	F	102.5
Northbound Through		244	320	F	88.3	312	#402	F	101.0

	Link/ Turn Bay Length	Existing				Proposed Alternative II			
		Queue Lengths (feet)		LOS	Delay (sec)	Queue Lengths (feet)		LOS	Delay (sec)
		50 th	95 th			50 th	95 th		
Northbound Right	520	348	475	F	83.8	287	396	F	86.0
Southbound Left	400	~474	#697	F	270.1	~308	#436	F	167.0
Southbound Through		232	#309	F	104.0	~310	#516	F	184.2
Southbound Right	880	~1004	#1260	F	479.8	0	0	A	0.6

Note:

 DETERIORATED  IMPROVED

FINDINGS AND CONCLUSIONS

As mentioned earlier, the analysis for alternatives evaluated based on the result of a meeting held with VDOT and Loudoun County Planning and Transportation staff on April 2, 2009, shows that the recommended improvements do not improve the level of service at the study intersection. This memorandum has taken elements from all of the requested alternatives and developed new (proposed) alternatives that improve the operations at the intersection.

This memorandum focuses on the impacts of the proposed alternatives on Waxpool Road and Pacific Boulevard intersection. The impacts of proposed alternatives were compared with the existing conditions at the study intersection. The analysis presented in this memorandum supports the following conclusions:

- During the existing conditions, the intersection operates at unacceptable level of service “F” in the PM peak hour.
- The intersection of Waxpool Road and Pacific Boulevard resulted in levels of service worse than the existing conditions for all three requested alternatives.
- The proposed alternative I helps improve the overall level of service for the study intersection, without affecting the eastbound-westbound approaches (main line). The queuing and delay for the southbound right turn movement is reduced drastically. However, an additional right turn lane in the southbound direction will be required to be constructed. Based on the queuing results, the length of the second right turn lane will have to be at least 500’.
- The proposed alternative II helps the intersection to operate at acceptable level of service “D” in the PM peak hour. However, the proposed alternative II results in slightly higher delays and longer queues in the westbound direction.
- The proposed alternatives I and II result in considerable improvements to the operations of the southbound intersection approach. However, alternative II, with the southbound right turn free flow movement in place, shows greater improvement in the level of service, delay and queuing.
- The following table shows the difference in overall and approach delay at the intersection of

Waxpool Road and Pacific Boulevard for the existing conditions and the proposed alternatives:

	Existing Conditions	Proposed Alternative I	Proposed Alternative II
Overall Delay (sec/veh)	23.7/85.3	23.5/56.6	22.6/50.0
EB Delay (sec/veh)	16.2/27.7	16.1/27.7	17.1/27.4
WB Delay (sec/veh)	23.7/39.1	23.6/39.1	22.3/41.4
NB Delay (sec/veh)	77.7/90.6	77.7/90.6	77.3/96.9
SB Delay (sec/veh)	79.9/331.5	79.1/140.0	61.6/85.0

XX/YY – AMPH/PMPH

- The above table shows that even though the delays in the westbound approach increase slightly, the proposed alternative II improves the overall delay and the delay in the southbound direction considerably.



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APPENDIX E

Intersection Capacity Analysis Results – Proposed Alternatives



APPENDIX A

EXISTING (2008) TRAFFIC VOLUMES & COUNT SHEETS

Gorron/Slade Associates

Project Name :

Project # :

Location :

Data Source :

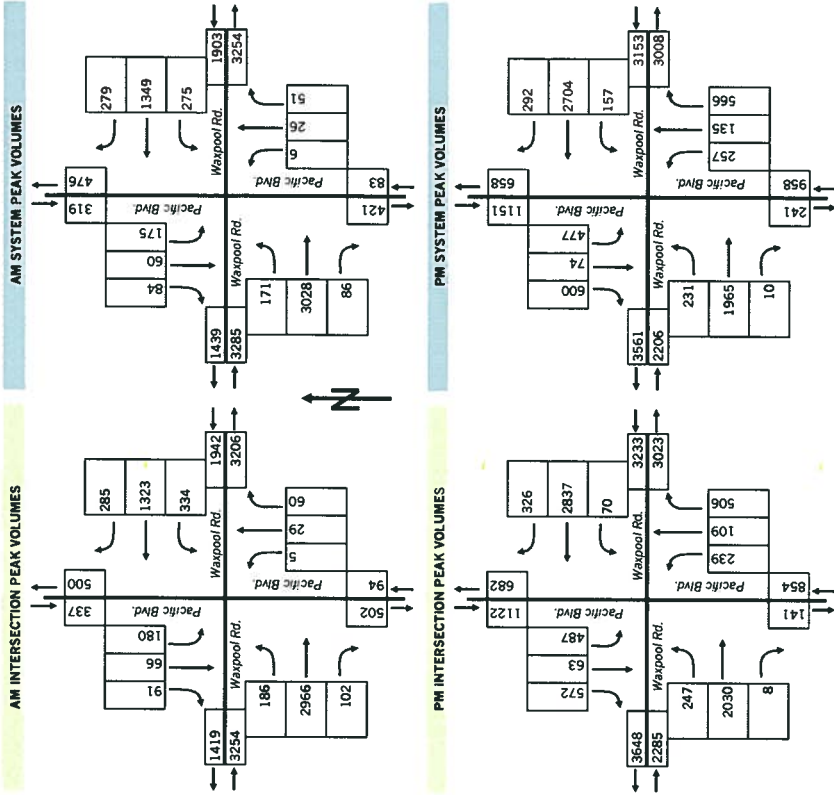
Messier Site
2103.001
Loudoun County

Intersection:

Pacific Boulevard at Waspool Road

Pacific Boulevard at Waspool Road																											
Intersection: AM PEAK	Direction: Roadway: Movement:		Southbound Pacific Blvd.						Westbound Waspool Rd.						Northbound Pacific Blvd.						Eastbound Waspool Rd.						
			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.									
			Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds									
6:00 AM to 6:15 AM		0	2	10	0	11	125	21	0	10	0	0	0	4	349	6	0										
6:15 AM to 6:30 AM		0	4	11	0	13	177	13	0	12	1	0	0	5	490	10	0										
6:30 AM to 6:45 AM		0	3	15	0	29	210	25	0	12	2	1	0	7	594	19	0										
6:45 AM to 7:00 AM		0	4	20	0	61	286	32	0	9	5	0	0	6	648	27	0										
7:00 AM to 7:15 AM		13	8	28	0	40	237	16	0	16	3	3	0	3	624	24	0										
7:15 AM to 7:30 AM		11	3	23	0	35	247	34	0	21	7	2	0	7	763	13	0										
7:30 AM to 7:45 AM		8	8	17	0	52	350	32	0	14	4	2	0	11	743	21	0										
7:45 AM to 8:00 AM		13	8	32	0	81	388	60	0	12	13	1	0	16	756	45	0										
8:00 AM to 8:15 AM		21	14	29	0	65	361	56	0	8	6	1	0	26	747	37	0										
8:15 AM to 8:30 AM		19	18	48	0	74	290	82	0	14	2	1	0	16	809	58	0										
8:30 AM to 8:45 AM		31	20	66	0	59	310	77	0	17	5	3	0	28	716	31	0										
8:45 AM to 9:00 AM		20	14	37	0	87	362	119	0	21	16	0	0	32	694	60	0										
PM PEAK																											
Intersection: PM PEAK	Direction: Roadway: Movement:		Southbound Pacific Blvd.						Westbound Waspool Rd.						Northbound Pacific Blvd.						Eastbound Waspool Rd.						
			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.									
			Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds									
4:00 PM to 4:15 PM		130	19	105	0	138	563	7	0	60	18	8	0	451	92	0											
4:15 PM to 4:30 PM		154	14	125	0	118	491	9	0	66	13	15	0	1	452	55	0										
4:30 PM to 4:45 PM		120	10	85	0	97	371	18	0	59	17	15	0	2	496	57	0										
4:45 PM to 5:00 PM		97	6	104	0	108	797	21	0	59	13	33	0	0	554	68	0										
5:00 PM to 5:15 PM		140	20	137	0	88	816	10	0	109	34	58	0	3	480	57	0										
5:15 PM to 5:30 PM		185	27	128	0	80	470	16	0	179	31	72	0	5	515	68	0										
5:30 PM to 5:45 PM		150	10	118	0	50	754	23	0	159	31	76	0	0	481	54	0										
5:45 PM to 6:00 PM		125	17	94	0	74	664	108	0	119	39	51	0	2	489	52	0										
6:00 PM to 6:15 PM		129	11	109	0	89	514	9	0	126	16	50	0	0	518	48	0										
6:15 PM to 6:30 PM		139	11	128	0	88	530	15	0	115	28	56	0	0	387	72	0										
6:30 PM to 6:45 PM		141	8	142	0	90	654	9	0	99	6	26	0	0	432	78	0										
6:45 PM to 7:00 PM		110	8	153	0	109	783	16	0	108	9	8	0	1	439	69	0										
PEAK HOURS																											
Intersection: PEAK HOURS	Direction: Roadway: Movement:		Southbound Pacific Blvd.						Westbound Waspool Rd.						Northbound Pacific Blvd.						Eastbound Waspool Rd.						
			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.			Pacific Blvd.			Waspool Rd.									
			Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds									
AM INTERSECTION PEAK HOUR		91	66	180	0	285	1323	334	0	60	29	5	0	102	2966	186	0										
PM INTERSECTION PEAK HOUR		572	63	487	0	326	2837	70	0	506	109	239	0	8	2030	247	0										
AM SYSTEM PEAK HOUR		84	60	175	0	279	1349	275	0	51	26	6	0	86	3028	171	0										
PM SYSTEM PEAK HOUR		600	74	477	0	292	2704	157	0	566	135	257	0	10	1965	231	0										
PEAK HOUR FACTORS																											
AM PEAK HOUR		0.68	0.75	0.66	N/A	0.86	0.87	0.84	N/A	0.75	0.50	0.50	N/A	0.77	0.94	0.74	N/A										
PM PEAK HOUR		0.81	0.69	0.87	N/A	0.83	0.83	0.36	N/A	0.79	0.87	0.85	N/A	0.50	0.95	0.85	N/A										
Overall AM PEAK HOUR FACTOR		=						0.98						0.98						0.96							
Overall PM PEAK HOUR FACTOR		=						0.98						0.98						0.96							
AM Period Intersection Volume:		1,3784						2,0465						2,0465						2,0465							
PM Period Intersection Volume:		2,0465						2,0465						2,0465						2,0465							

Date of Counts: Dec 17 and 18, 2008
AM Weather Conditions:
PM Weather Conditions:





APPENDIX B

LEVEL OF SERVICE DEFINITIONS



LEVEL OF SERVICE DEFINITIONS

All capacity analyses are based on the procedures specified by the Transportation Research Board, Special Report 209: *Highway Capacity Manual (HCM)*, 2000. Levels of service (LOS) range from A to F. A brief description of each level of service for signalized and unsignalized intersections is provided below.

Signalized Intersections: Level of service is based upon the traffic volume present in each lane on the roadway, the capacity of each lane at the intersection and the delay associated with each directional movement. The levels of service for signalized intersections are defined below:

- Level of Service A describes operations with very low average delay per vehicle, i.e., less than 10.0 seconds. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop. Short signal cycle lengths may also contribute to low delay.
 - Level of Service B describes operations with average delay in the range of 10.1 to 20.0 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
 - Level of Service C describes operations with delay in the range of 20.1 to 35.0 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level although many still pass through the intersection without stopping. This is generally considered the lower end of the range of the acceptable level of service in rural areas.
 - Level of Service D describes operations with delay in the range of 35.1 to 55.0 seconds per vehicle. At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, and/or high traffic volumes as compared to the roadway capacity. Many vehicles are required to stop and the number of vehicles that do not have to stop declines. Individual signal cycle failures, where all waiting vehicles do not clear the intersection during a single green time, are noticeable. This is generally considered the lower end of the range of the acceptable level of service in urban areas.
 - Level of Service E describes operations with delay in the range of 55.1 to 80.0 seconds per vehicle. These higher delay values generally indicate poor progression, long cycle lengths, and high traffic volumes. Individual cycle failures are frequent occurrences. LOS E has been set as the limit of acceptable conditions.
 - Level of Service F describes operations with average delay in excess of 80.0 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over-
-



saturation, i.e., when traffic arrives at a flow rate that exceeds the capacity of the intersection. It may also occur at high volumes with many individual cycle failures. Poor progression and long cycle lengths may also contribute to such delays.

Unsignalized Intersections: At an unsignalized intersection, the major street through traffic and right turns are assumed to operate unimpeded and therefore receive no level of service rating. The level of service for the minor street and the major street left turn traffic is dependent on the volume and capacity of the available lanes, and, the number and frequency of acceptable gaps in the major street traffic to make a conflicting turn. The level of service grade is provided for each conflicting movement at an unsignalized intersection and is based on the total average delay experienced by each vehicle. The delay includes the time it takes a vehicle to move from the back of a queue through the intersection.

The unsignalized intersection level of service analysis does not account for variations in driver behavior or the effects of nearby traffic signals. Therefore, the results from this analysis usually indicates worse levels of service than may be experienced in the field. The unsignalized intersection level of service descriptions are provided below:

- Level of Service A. Describes operations where there is very little to no conflicting traffic for a minor side street movement, i.e., an average total delay of less than 10.0 seconds per vehicle.
 - Level of Service B. Describes operations with average total delay in the range of 10.1 to 15.0 seconds per vehicle.
 - Level of Service C. Describes operations with average total delay in the range of 15.1 to 25.0 second per vehicle.
 - Level of Service D. Describes operations with average total delay in the range of 25.1 to 35.0 seconds per vehicle.
 - Level of Service E. Describes operations with average total delay in the range of 35.1 to 50.0 seconds per vehicle.
 - Level of Service F. Describes operations with average total delay of 50 seconds per vehicle. LOS F exists when there are insufficient gaps of suitable size to allow a side street demand to cross safely through or enter a major street traffic stream. This level of service is generally evident from extremely long total delays experienced by side street traffic and by queuing on the minor approaches. It is important to note that LOS F may not always result in long queues but may result in adjustments to normal driver behavior.
-



APPENDIX C

INTERSECTION CAPACITY ANALYSIS RESULTS – EXISTING CONDITIONS

Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Existing

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group Flow (vph)	186	2966	102	334	1608	4	60	30	90	156	91	
v/c Ratio	0.56	0.90	0.10	0.89	0.37	0.04	0.30	0.09	0.61	0.52	0.30	
Control Delay	108.8	12.0	1.0	83.6	12.1	84.2	49.8	37.5	100.5	88.3	54.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	108.8	12.0	1.0	83.6	12.1	84.2	49.8	37.5	100.5	88.3	54.6	
Queue Length 50th (ft)	121	828	6	179	200	5	21	18	119	103	87	
Queue Length 95th (ft)	m124	1136	m11	193	212	20	52	52	195	148	135	
Internal Link Dist (ft)	508			1140		1295				1021		
Turn Bay Length (ft)	460	415		1000		290		370	385			
Base Capacity (vph)	398	3278	1046	705	4314	119	246	317	161	330	313	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.47	0.90	0.10	0.47	0.37	0.03	0.24	0.09	0.56	0.47	0.29	

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Existing

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	111	111	111	111	111	111	111	111	111	111	111	
Volume (vph)	186	2966	102	334	1323	285	5	29	60	180	66	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.91	0.86	0.91	0.91	0.91	0.91	0.91
Flt	1.00	1.00	0.85	1.00	0.97	1.00	0.92	0.85	1.00	1.00	0.85	1.00
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	0.97	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	6237	1610	2961	1441	1610	3295	1583	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	0.97	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	6237	1610	2961	1441	1610	3295	1583	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	186	2966	102	334	1323	285	5	29	60	180	66	91
RTOR Reduction (vph)	0	0	25	0	18	0	28	10	0	0	0	0
Lane Group Flow (vph)	186	2966	77	334	1590	0	4	32	20	90	156	91
Turn Type	Prot	Perm	Prot	Prot	Perm	Split	Split	pm-tov	Split	pm-tov	Split	pm-tov
Protected Phases	1	6	5	2	4	4	5	3	3	1	3	1
Permitted Phases	1	6	5	2	4	4	5	3	3	1	3	1
Actuated Green, G (s)	14.5	118.5	118.5	23.0	127.0	7.1	7.1	30.1	13.4	13.4	27.9	27.9
Effective Green, g (s)	18.5	122.5	122.5	27.0	131.0	11.1	11.1	38.1	17.4	17.4	35.9	35.9
Actuated g/C Ratio	0.10	0.64	0.64	0.14	0.69	0.06	0.06	0.20	0.09	0.09	0.19	0.19
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	334	3278	1021	488	4300	94	173	312	147	302	299	299
v/s Ratio Prot	0.05	c0.58	0.05	c0.10	0.25	0.00	c0.01	0.01	c0.06	0.05	0.03	0.03
v/s Ratio Perm	0.56	0.90	0.08	0.68	0.37	0.04	0.18	0.06	0.61	0.52	0.30	0.30
Uniform Delay, d1	81.8	28.8	12.6	77.5	12.3	84.4	85.1	61.5	83.1	82.3	66.3	66.3
Progression Factor	1.30	0.32	0.17	0.99	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	1.9	0.1	3.2	0.2	0.1	0.2	0.0	5.2	0.6	0.2	0.2
Delay (s)	107.2	11.0	2.3	79.6	12.1	84.5	85.3	61.5	88.3	82.9	66.5	66.5
Level of Service	F	B	A	E	B	F	F	E	F	F	F	E
Approach Delay (s)	16.2			23.7								
Approach LOS	B			C								
Intersection Summary												
HCM Average Control Delay				23.7								
HCM Volume to Capacity ratio				0.80								
Actuated Cycle Length (s)				190.0								
Intersection Capacity Utilization				88.5%								
Analysis Period (min)				15								
c Critical Lane Group												

Queues 11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Existing

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group Flow (vph)	247	2030	8	70	3163	208	393	253	243	307	572	
v/c Ratio	0.89	0.65	0.01	0.34	0.65	0.82	0.85d	0.74	1.32	1.27d	1.85	
Control Delay	122.8	16.8	4.1	98.1	38.0	109.5	76.1	86.0	240.8	108.8	428.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	122.8	16.8	4.1	98.1	38.0	109.5	76.1	86.0	240.8	108.8	428.2	
Queue Length 50th (ft)	180	335	0	48	1029	309	244	348	-474	232	-1004	
Queue Length 95th (ft)	#270	347	m1	80	1048	#454	320	475	#697	#309	#1280	
Internal Link Dist (ft)	508			1140		1285				1021		
Turn Bay Length (ft)	460	415	1000		290		370	385				
Base Capacity (vph)	278	3108	971	229	3733	261	535	341	184	373	309	
Survival Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.89	0.65	0.01	0.31	0.85	0.80	0.73	0.74	1.32	0.82	1.85	

Intersection Summary
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.
 d Defacto Left Lane. Recode with 1 though lane as a left lane.
 dr Defacto Right Lane. Recode with 1 though lane as a right lane.

HCM Signalized Intersection Capacity Analysis 11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Existing

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Volume (vph)	247	2030	8	70	2837	326	239	109	506	487	63	572
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util Factor	0.97	0.91	1.00	0.97	0.86	0.91	0.86	0.91	0.86	0.91	0.91	
Flt	1.00	1.00	0.85	1.00	0.98	1.00	0.90	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	0.98	1.00	
Satd. Flow (prot)	3433	5085	1583	3433	6309	1610	2883	1441	1610	3261	1583	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	0.96	1.00	
Satd. Flow (perm)	3433	5085	1583	3433	6309	1610	2883	1441	1610	3261	1583	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	247	2030	8	70	2837	326	239	109	506	487	63	572
RTOR Reduction (vph)	0	0	3	0	9	0	0	69	7	0	0	
Lane Group Flow (vph)	247	2030	5	70	3154	0	208	324	246	243	307	572
Turn Type	Prot	Perm	Prot	Perm	Prot	Split	pmrov	Split	pmrov	Split	pmrov	
Protected Phases	1	6	5	2	4	4	5	3	3	1		
Permitted Phases	13.0	124.4	124.4	8.5	119.9	28.1	28.1	37.6	20.0	20.0	33.0	
Effective Green, G (s)	17.0	128.4	128.4	12.5	123.9	33.1	33.1	45.6	24.0	24.0	41.0	
Actuated v/c Ratio	0.08	0.61	0.61	0.08	0.59	0.16	0.16	0.22	0.11	0.11	0.20	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	278	3109	968	204	3722	254	454	333	184	373	309	
v/c Ratio Prot	0.07	0.40	0.00	0.02	0.50	0.13	0.11	0.04	0.15	0.08	0.15	
v/c Ratio Perm	0.89	0.65	0.01	0.34	0.85	0.82	0.85d	0.74	1.32	1.27d	1.85	
Uniform Delay, d1	95.6	26.4	15.9	94.8	35.3	85.6	83.9	76.6	90.9	84.5	84.5	
Progression Factor	1.05	0.60	0.54	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	20.5	0.8	0.0	0.4	2.6	17.4	4.4	7.2	177.1	13.0	395.3	
Delay (s)	120.5	16.5	8.7	95.2	37.9	102.9	88.3	83.8	270.1	104.0	479.8	
Level of Service	F	B	A	F	D	F	F	F	F	F	F	
Approach Delay (s)	27.7		39.1			90.6			331.5			
Approach LOS	C		D			F			F			

Intersection Summary
 HCM Average Control Delay 85.3 HCM Level of Service F
 HCM Volume to Capacity ratio 1.05
 Actuated Cycle Length (s) 210.0 Sum of lost time (s) 12.0
 Intersection Capacity Utilization 102.2% ICU Level of Service G
 Analysis Period (min) 15
 d Defacto Left Lane. Recode with 1 though lane as a left lane.
 dr Defacto Right Lane. Recode with 1 though lane as a right lane.
 c Critical Lane Group



APPENDIX D

INTERSECTION CAPACITY ANALYSIS RESULTS – REQUESTED ALTERNATIVES

Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 1

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	186	2966	102	334	1608	5	47	42	180	66	91
v/c Ratio	0.56	0.92	0.10	0.69	0.38	0.03	0.42	0.12	0.57	0.22	0.21
Control Delay	108.1	13.8	1.1	84.7	13.2	85.8	96.2	45.6	89.8	71.9	54.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	108.1	13.8	1.1	84.7	13.2	85.8	96.2	45.6	89.8	71.9	54.2
Queue Length 50th (ft)	118	1008	7	208	239	3	60	34	112	71	85
Queue Length 95th (ft)	m124	#191	m11	258	278	11	112	72	157	133	149
Internal Link Dist (ft)	508			1140			1295			1021	
Turn Bay Length (ft)	460	415	1000		290		370		385		
Base Capacity (vph)	398	3232	1032	705	4259	253	123	434	343	301	464
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.92	0.10	0.47	0.38	0.02	0.38	0.10	0.52	0.22	0.20

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 1

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111	1111
Volume (vph)	186	2966	102	334	1323	285	5	29	60	180	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.97	0.95	0.95	0.97	1.00	1.00
Flt Protected	1.00	1.00	0.85	1.00	0.87	1.00	0.94	0.85	1.00	1.00	0.85
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00	1.00	0.95
Satd. Flow (prot)	3433	5065	1583	3433	6237	3433	1668	1504	3433	1663	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	186	2966	102	334	1323	285	5	29	60	180	91
RTOR Reduction (vph)	0	0	28	0	20	0	0	0	7	0	0
Lane Group Flow (vph)	186	2966	74	334	1588	0	5	47	35	180	66

Turn Type	Prot	1	6	5	2	7	4	4.5	3	8	1
Protected Phases											
Permitted Phases											
Actuated Green, G (s)	14.5	111.2	111.2	23.0	119.7	1.2	14.3	44.3	13.5	26.6	41.1
Effective Green, g (s)	18.5	115.2	115.2	27.0	123.7	5.2	18.3	48.3	17.5	30.6	49.1
Actuated g/C Ratio	0.10	0.61	0.61	0.14	0.65	0.03	0.10	0.25	0.09	0.16	0.26
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	334	3083	960	488	4061	94	161	382	316	300	434
v/s Ratio Prot	0.05	c0.58		c0.10	0.25	0.00	c0.03	0.02	c0.05	0.04	0.02
v/s Ratio Perm	0.56	0.96	0.08	0.88	0.39	0.05	0.29	0.09	0.57	0.22	0.21
Uniform Delay, d1	81.8	35.3	15.4	77.5	15.5	90.0	79.8	54.1	82.6	69.3	55.2
Progression Factor	1.30	0.35	0.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	4.5	0.1	3.2	0.3	0.1	0.4	0.0	1.4	0.1	0.1
Delay (s)	106.5	16.8	3.0	80.6	15.8	90.1	80.2	54.1	84.0	69.5	55.3
Level of Service	F	B	A	F	B	F	F	D	F	E	E
Approach Delay (s)		21.5		26.9		66.1			73.4		
Approach LOS		C		C		E			E		

Intersection Summary											
HCM Average Control Delay	27.3										
HCM Volume to Capacity ratio	0.81										
Actuated Cycle Length (s)	190.0										
Intersection Capacity Utilization	88.6%										
Analysis Period (min)	15										
c Critical Lane Group											

Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 1

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	247	2030	8	70	3163	239	316	299	487	63	572
v/c Ratio	0.89	0.66	0.01	0.33	0.85	0.63	1.22	0.82	1.24	0.20	1.38
Control Delay	123.0	15.2	3.1	98.6	38.7	96.9	197.4	92.3	198.3	79.0	238.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	123.0	15.2	3.1	98.6	38.7	96.9	197.4	92.3	198.3	79.0	238.2
Queue Length 50th (ft)	180	291	1	48	1028	166	~563	404	~428	77	~1046
Queue Length 95th (ft)	#271	311	m1	80	1047	214	#794	#550	#555	134	#1355
Internal Link Dist (ft)	508				1140		1295			1021	
Turn Bay Length (ft)	460		415	1000		290		370	385		
Base Capacity (vph)	278	3081	962	229	3707	539	258	372	392	310	414
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.66	0.01	0.31	0.85	0.44	1.22	0.80	1.24	0.20	1.38

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 1

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	111	111	111	111	111	111	111	111	111	111	111
Volume (vph)	247	2030	8	70	2837	326	239	109	506	487	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.97	0.95	0.95	0.97	1.00	1.00
Flt	1.00	1.00	0.85	1.00	0.98	1.00	0.90	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	6309	3433	1586	1504	3433	1883	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	6309	3433	1586	1504	3433	1883	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	247	2030	8	70	2837	326	239	109	506	487	63
RTOR Reduction (vph)	0	0	3	0	10	0	0	0	7	0	0
Lane Group Flow (vph)	247	2030	5	70	3153	0	239	316	282	487	63

Turn Type Prot Perm Prot Prot phtov Prot phtov

Protected Phases 1 6 6 5 2 7 4 4 5 3 8 1

Permitted Phases 13.0 123.2 123.2 8.8 119.0 19.1 30.0 45.8 20.0 30.9 43.9 8

Actuated Green, G (s) 17.0 127.2 127.2 12.8 123.0 23.1 34.0 49.8 24.0 34.9 51.9

Effective Green, g (s) 0.08 0.61 0.61 0.06 0.59 0.11 0.16 0.24 0.11 0.17 0.25

Actuated g/C Ratio 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0

Clearance Time (s) 2.0 3.0 3.0 2.0 3.0 2.0 2.0 2.0 2.0 2.0 2.0

Vehicle Extension (s) 278 3080 959 209 3695 378 258 357 392 310 414

Lane Grp Cap (vph) 0.07 0.40 0.02 c0.50 0.07 0.20 0.19 c0.14 0.03 c0.11

v/s Ratio Prot 0.89 0.66 0.01 0.33 0.85 0.63 1.22 0.82 1.24 0.20 1.38

v/c Ratio 95.6 27.2 16.4 94.5 36.0 88.4 88.0 75.8 93.0 75.6 79.0

Uniform Delay, d1 1.05 0.52 0.41 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Progression Factor 20.5 0.8 0.0 0.3 2.7 2.5 130.6 12.9 129.0 0.1 186.3

Incremental Delay, d2 120.7 15.0 6.7 94.9 38.8 91.9 218.6 88.7 222.0 75.7 285.3

Delay (s) Level of Service F B A F D D F F F F E F

Approach Delay (s) 26.4 40.0 137.7 235.8 F

Approach LOS C D D F

Intersection Summary

HCM Average Control Delay 76.3 HCM Level of Service E

HCM Volume to Capacity ratio 1.03

Actuated Cycle Length (s) 210.0 Sum of lost time (s) 6.0

Intersection Capacity Utilization 98.8% ICU Level of Service F

Analysis Period (min) 15

c Critical Lane Group

Queues 11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 2

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	186	2966	102	334	1608	5	47	42	180	66	91
v/c Ratio	0.56	0.92	0.10	0.69	0.38	0.03	0.42	0.12	0.57	0.22	0.18
Control Delay	108.1	13.8	1.1	84.7	13.2	85.8	96.2	45.6	88.8	71.9	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	108.1	13.8	1.1	84.7	13.2	85.8	96.2	45.6	88.8	71.9	9.4
Queue Length 50th (ft)	118	1008	7	208	239	3	60	34	112	71	0
Queue Length 95th (ft)	m124	#1191	m11	258	278	11	112	72	157	133	51
Internal Link Dist (ft)	508			1140		1205			1021		
Turn Bay Length (ft)	460		415	1000		290		370	385		
Base Capacity (vph)	398	3232	1032	705	4259	253	123	434	343	301	528
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.92	0.10	0.47	0.38	0.02	0.38	0.10	0.52	0.22	0.17

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis 11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 2

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	W	W	W	W	W	W	W	W	W	W	W
Volume (vph)	186	2966	102	334	1323	285	5	29	60	180	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.97	0.95	0.95	0.97	1.00	0.85
Flt	1.00	1.00	0.85	1.00	0.97	1.00	0.94	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	6237	3433	1668	1504	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Peak-hour factor, PHF	3433	5085	1583	3433	6237	3433	1668	1504	3433	1863	1583
Satd. Flow (perm)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	186	2966	102	334	1323	285	5	29	60	180	66
RTOR Reduction (vph)	0	0	28	0	20	0	0	0	7	0	67
Lane Group Flow (vph)	186	2966	74	334	1588	0	5	47	35	180	66

Turn Type	Prot	1	6	5	2	7	4	4	5	3	8	1
Protected Phases												
Permitted Phases												
Actuated Green, G (s)	14.5	111.2	111.2	23.0	118.7	1.2	14.3	44.3	13.5	26.6	41.1	8
Effective Green, g (s)	18.5	115.2	115.2	27.0	123.7	5.2	18.3	48.3	17.5	30.6	49.1	
Actuated g/C Ratio	0.10	0.61	0.61	0.14	0.65	0.03	0.10	0.25	0.09	0.16	0.26	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	334	3083	960	488	4061	94	161	382	316	300	434	
v/c Ratio Prot	0.05	c0.58	c0.10	0.25	0.00	c0.03	0.02	c0.05	0.04	0.01	0.01	
v/c Ratio Perm	0.56	0.96	0.08	0.68	0.39	0.05	0.29	0.09	0.57	0.22	0.05	
Uniform Delay, d1	81.8	35.3	15.4	77.5	15.5	90.0	79.8	54.1	82.6	69.3	53.0	
Progression Factor	1.30	0.35	0.19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	4.5	0.1	3.2	0.3	0.1	0.4	0.0	1.4	0.1	0.0	
Delay (s)	106.5	16.8	3.0	80.6	15.8	90.1	80.2	54.1	84.0	69.5	53.0	
Level of Service	F	B	A	F	B	F	F	D	F	E	D	
Approach Delay (s)	21.5			26.9		68.1						
Approach LOS	C			C		E						

Intersection Summary												
HCM Average Control Delay	27.3											
HCM Volume to Capacity ratio	0.81											
Actuated Cycle Length (s)	190.0											
Intersection Capacity Utilization	88.6%											
Analysis Period (min)	15											
c Critical Lane Group												

Queues
11: Waxpool Rd & Pacific Blvd. Waxpool Pacific Intersection Modification
Requested Option 2

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	247	2030	8	70	3163	239	316	299	487	63	572
v/c Ratio	0.89	0.66	0.01	0.33	0.85	0.63	1.22	0.82	1.24	0.20	1.32
Control Delay	123.0	15.2	3.1	98.6	38.7	96.9	197.4	92.3	196.3	79.0	213.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	123.0	15.2	3.1	98.6	38.7	96.9	197.4	92.3	196.3	79.0	213.8
Queue Length 50th (ft)	180	291	1	48	1028	166	-563	404	-428	77	-997
Queue Length 95th (ft)	#271	311	m1	80	1047	214	#794	#550	#555	134	#1310
Internal Link Dist (ft)	508				1140		1285			1021	
Turn Bay Length (ft)	460		415	1000		290		370	385		
Base Capacity (vph)	278	3081	962	229	3707	539	258	372	392	310	432
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.66	0.01	0.31	0.85	0.44	1.22	0.80	1.24	0.20	1.32

- Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd. Waxpool Pacific Intersection Modification
Requested Option 2

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	111	111	111	111	111	111	111	111	111	111	111
Volume (vph)	247	2030	8	70	2837	326	239	106	506	487	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.97	0.95	0.95	0.97	1.00	1.00
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	6309	3433	1596	1504	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	6309	3433	1596	1504	3433	1863	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	247	2030	8	70	2837	326	239	106	506	487	63
RTOR Reduction (vph)	0	0	3	0	10	0	0	0	7	0	18
Lane Group Flow (vph)	247	2030	5	70	3153	0	239	316	292	487	63

Turn Type Prot Perm Prot Prot

Protected Phases 1 6 6 5 2 7 4 4 5 3 8 1

Permitted Phases 13.0 123.2 123.2 8.8 119.0 19.1 30.0 45.8 20.0 30.9 43.9 8

Effective Green, G (s) 17.0 127.2 127.2 12.8 123.0 23.1 34.0 49.8 24.0 34.9 51.9

Effective Green, g (s) 0.08 0.61 0.61 0.06 0.59 0.11 0.16 0.24 0.11 0.17 0.25

Actuated g/C Ratio 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0

Clearance Time (s) 2.0 3.0 3.0 3.0 3.0 2.0 2.0 2.0 2.0 2.0 2.0

Vehicle Extension (s) 278 3080 959 209 3695 378 258 357 392 310 414

Lane Grp Cap (vph) 0.07 0.40 0.02 c0.50 0.07 0.20 0.19 c0.14 0.03 c0.11

v/c Ratio Prot 0.89 0.66 0.01 0.33 0.85 0.63 1.22 0.82 1.24 0.20 1.34

v/c Ratio Perm 95.6 27.2 16.4 94.5 36.0 88.4 88.0 75.8 75.6 79.0

Uniform Delay, d1 1.05 0.52 0.41 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Progression Factor 20.5 0.8 0.0 0.3 2.7 2.5 130.6 12.9 129.0 0.1 187.7

Incremental Delay, d2 120.7 15.0 6.7 94.9 38.8 91.9 216.6 88.7 222.0 75.7 246.8

Delay (s) Level of Service F B A F D F F F F F E F

Approach Delay (s) 26.4 40.0 137.7 226.4 F

Approach LOS C D D

Intersection Summary

HCM Average Control Delay 74.9 HCM Level of Service E

HCM Volume to Capacity ratio 1.02

Actuated Cycle Length (s) 210.0 Sum of lost time (s) 6.0

Intersection Capacity Utilization 98.8% ICU Level of Service F

Analysis Period (min) 15

c Critical Lane Group

Queues
17: Waxpool Road & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 3

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	251	3155	132	398	1852	10	73	85	273	117	105
v/c Ratio	0.67	1.03	0.13	0.72	0.45	0.05	0.59	0.17	0.80	0.43	0.22
Control Delay	90.5	59.9	6.9	83.4	15.9	85.6	105.4	53.3	100.6	79.8	9.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	90.5	59.9	6.9	83.4	15.9	85.6	105.4	53.3	100.6	79.8	9.9
Queue Length 50th (ft)	157	-1535	23	247	313	6	94	64	175	135	0
Queue Length 95th (ft)	169	#1555	44	276	319	10	86	90	164	189	16
Internal Link Dist (ft)	530			1136			519			1128	
Turn Bay Length (ft)	430	410	1000			330		520	400		880
Base Capacity (vph)	388	3074	990	705	4108	253	126	440	343	270	489
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	1.03	0.13	0.56	0.45	0.04	0.56	0.15	0.80	0.43	0.21

~ Volume exceeds capacity, queue is theoretically infinite.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
17: Waxpool Road & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 3

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	186	2866	102	334	1323	285	5	29	60	180	66
Volume (vph)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Ideal Flow (vphpl)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost time (s)	0.97	0.91	1.00	0.97	0.86	1.00	0.97	0.85	1.00	0.96	0.85
Lane Util. Factor	1.00	1.00	0.85	1.00	0.97	1.00	0.97	0.85	1.00	0.96	0.85
Flt	0.85	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Flt Protected	3433	5085	1583	3433	6236	3433	1715	1504	3433	1704	1504
Satd. Flow (prot)	0.95	1.00	1.00	0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Flt Permitted	3433	5085	1583	3433	6236	3433	1715	1504	3433	1704	1504
Peak-hour factor, PHF	0.74	0.94	0.77	0.84	0.87	0.86	0.50	0.50	0.75	0.86	0.75
Adj. Flow (vph)	251	3155	132	398	1521	331	10	58	80	273	88
RTOR Reduction (vph)	0	0	35	0	22	0	0	0	2	0	0
Lane Group Flow (vph)	251	3155	97	398	1830	0	10	73	63	273	117

Turn Type Prot Perm Prot Prot

Protected Phases 1 6 6 5 2 7 4 4 5 3 8 8 1

Permitted Phases 16.8 106.7 106.7 26.5 116.4 2.7 13.8 47.3 15.0 26.1 49.9

Actuated Green, G (s) 20.8 110.7 110.7 30.5 120.4 6.7 17.8 51.3 19.0 30.1 50.9

Effective Green, g (s) 0.11 0.58 0.58 0.16 0.63 0.04 0.09 0.27 0.10 0.16 0.27

Actuated g/C Ratio 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0

Clearance Time (s) 2.0 3.0 3.0 2.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0

Vehicle Extension (s) 376 2963 922 551 3952 121 161 406 343 270 403

Lane Grp Cap (vph) 0.07 c0.62 0.06 c0.12 0.29 0.00 0.04 0.04 c0.08 c0.07 0.02

v/c Ratio Prot 0.67 1.06 0.10 0.72 0.46 0.08 0.45 0.15 0.80 0.43 0.07

v/c Ratio Perm 81.3 39.7 17.6 75.7 18.0 88.7 81.5 52.8 83.6 72.2 51.9

Uniform Delay, d1 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Progression Factor 3.5 37.0 0.2 4.0 0.4 0.3 2.0 0.2 12.0 1.1 0.1

Incremental Delay, d2 84.7 76.7 17.9 79.7 18.4 89.0 83.5 53.0 95.7 73.4 52.0

Delay (s) F E B E B F F F D F E D

Level of Service F E B E B C

Approach Delay (s) 75.0 28.3 70.5 81.1

Approach LOS E C E F F

Intersection Summary

HCM Average Control Delay 58.4 HCM Level of Service E

HCM Volume to Capacity ratio 0.91

Actuated Cycle Length (s) 190.0 Sum of lost time (s) 9.0

Intersection Capacity Utilization 88.6% ICU Level of Service E

Analysis Period (min) 15

c Critical Lane Group

Queues
17: Waxpool Road & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 3

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	291	2137	16	194	3811	281	394	372	560	409	388
v/c Ratio	1.05	0.70	0.02	0.85	1.03	0.85	1.53	1.00	1.43	1.75	1.08
Control Delay	163.8	20.6	6.8	125.7	64.6	94.2	309.6	122.3	265.3	397.5	138.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	163.8	20.6	6.8	125.7	64.6	94.2	309.6	122.3	265.3	397.5	138.0
Queue Length 50th (ft)	~227	348	1	139	~1625	194	~788	~545	~536	~878	~609
Queue Length 95th (ft)	#310	408	3	73	1286	229	#937	#630	#635	#843	#773
Internal Link Dist (ft)	530			254		519				1128	
Turn Bay Length (ft)	430		410	1000		330		520	400		880
Base Capacity (vph)	278	3051	956	229	3707	539	257	371	392	234	359
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.05	0.70	0.02	0.85	1.03	0.85	1.53	1.00	1.43	1.75	1.08

~ Volume exceeds capacity, queue is theoretically infinite.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
17: Waxpool Road & Pacific Blvd.

Waxpool Pacific Intersection Modification
Requested Option 3

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	W	W	W	W	W	W	W	W	W	W	W
Volume (vph)	247	2030	8	70	2837	326	239	109	506	487	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.97	0.95	0.95	0.97	0.95	0.95
Flt Protected	1.00	1.00	0.85	1.00	0.98	1.00	0.90	0.85	1.00	0.88	0.85
Flt Permitted	0.95	1.00	0.95	1.00	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	6309	3433	1588	1504	3433	1583	1504
Satd. Flow (perm)	3433	5085	1583	3433	6309	3433	1588	1504	3433	1583	1504
Peak-hour factor, PHF	0.85	0.95	0.50	0.36	0.83	0.83	0.85	0.87	0.79	0.87	0.81
Adj. Flow (vph)	291	2137	16	194	3418	383	281	125	644	560	91
RTOR Reduction (vph)	0	0	6	0	10	0	0	0	5	0	0
Lane Group Flow (vph)	291	2137	10	194	3801	0	281	384	367	560	409
Turn Type	Prot	Perm	Prot	Prot	Prot	Prot	Prot	Prot	Prot	Prot	Prot
Protected Phases	1	6	5	2	2	7	4	4	5	3	8
Permitted Phases	6										
Actuated Green, G (s)	13.0	122.0	122.0	10.0	119.0	22.5	30.0	47.0	20.0	27.5	47.5
Effective Green, g (s)	17.0	126.0	126.0	14.0	123.0	26.5	34.0	51.0	24.0	31.5	48.5
Actuated g/C Ratio	0.08	0.60	0.60	0.07	0.59	0.13	0.16	0.24	0.11	0.15	0.23
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	3051	950	229	3695	433	257	365	392	234	347
v/c Ratio Prot	0.08	c0.42	0.06	c0.60	0.08	0.25	0.24	c0.16	c0.26	c0.25	c0.25
v/c Ratio Perm			0.01								
v/c Ratio	1.05	0.70	0.01	0.85	1.03	0.65	1.53	1.00	1.43	1.75	1.08
Uniform Delay, d1	96.5	29.0	16.9	96.9	43.5	87.3	88.0	79.5	93.0	89.2	80.8
Progression Factor	1.14	0.66	1.02	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	64.6	1.3	0.0	23.2	22.8	3.3	258.6	48.3	207.1	353.6	72.2
Delay (s)	174.7	20.4	17.2	120.1	66.3	90.7	346.6	127.8	300.1	442.9	153.0
Level of Service	F	C	B	F	E	F	F	F	F	F	F
Approach Delay (s)	38.8			68.9		200.2				301.1	
Approach LOS	D			E		F				F	

Intersection Summary
HCM Average Control Delay 111.7 HCM Level of Service F
HCM Volume to Capacity ratio 1.18
Actuated Cycle Length (s) 210.0 Sum of lost time (s) 12.0
Intersection Capacity Utilization 96.9% ICU Level of Service F
Analysis Period (min) 15
c Critical Lane Group



APPENDIX E

INTERSECTION CAPACITY ANALYSIS RESULTS – PROPOSED ALTERNATIVES

Queues

11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification

Proposed Option 1

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Group Flow (vph)	186	2966	102	334	1608	4	60	30	162	84	91	
v/c Ratio	0.56	0.90	0.10	0.69	0.37	0.04	0.30	0.09	0.55	0.55	0.17	
Control Delay	108.9	11.9	1.0	83.6	12.0	84.2	49.8	37.5	90.0	96.3	51.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	108.9	11.9	1.0	83.6	12.0	84.2	49.8	37.5	90.0	96.3	51.3	
Queue Length 50th (ft)	122	763	5	179	196	5	21	18	108	112	48	
Queue Length 95th (ft)	m124	1136	m11	193	212	20	52	52	154	184	73	
Internal Link Dist (ft)	508			1140			1285			1021		
Turn Bay Length (ft)	460		415	1000		290		370	385		500	
Base Capacity (vph)	398	3282	1047	705	4319	119	246	317	322	168	551	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.47	0.90	0.10	0.47	0.37	0.03	0.24	0.09	0.50	0.50	0.17	

m. Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis

11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification

Proposed Option 1

	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	444	444	444	444	444	444	444	444	444	444	444	
Volume (vph)	186	2966	102	334	1323	285	5	29	60	180	66	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.91	0.86	0.91	0.91	0.91	0.88	
Flt Protected	0.95	1.00	1.00	0.85	1.00	0.95	1.00	0.85	1.00	1.00	0.85	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00	1.00	0.95	
Satd. Flow (prot)	3433	5085	1583	3433	6237	1610	2961	1441	3221	1677	2787	
Satd. Flow (perm)	3433	5085	1583	3433	6237	1610	2961	1441	3221	1677	2787	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	186	2966	102	334	1323	285	5	29	60	180	66	91
RTOR Reduction (vph)	0	0	25	0	18	0	0	28	10	0	0	
Lane Group Flow (vph)	186	2966	77	334	1590	0	4	32	20	162	84	91

Turn Type	Prot	Perm	Prot	Split	pm+ov	Split	pm+ov
Protected Phases	1	6	5	2	4	4	5
Permitted Phases							
Actuated Green, G (s)	14.5	118.7	118.7	23.0	127.2	7.1	7.1
Effective Green, g (s)	18.5	122.7	122.7	27.0	131.2	11.1	11.1
Actuated g/C Ratio	0.10	0.65	0.65	0.14	0.69	0.06	0.06
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0
Lane Grp Cap (vph)	334	3284	1022	488	4307	94	173
v/c Ratio Prot	0.05	c0.58		c0.10	0.25	0.00	c0.01
v/c Ratio Perm			0.05			0.01	c0.05
v/c Ratio	0.56	0.90	0.08	0.88	0.37	0.04	0.18
Uniform Delay, d1	81.8	28.6	12.5	77.5	12.2	84.4	85.1
Progression Factor	1.31	0.31	0.17	0.99	0.97	1.00	1.00
Incremental Delay, d2	0.4	1.9	0.1	3.2	0.2	0.1	0.2
Delay (s)	107.3	10.8	2.2	79.6	12.0	84.5	85.3
Level of Service	F	B	A	E	B	F	F
Approach Delay (s)		16.1		23.6		77.7	79.1
Approach LOS		B		C		E	E

Intersection Summary

HCM Average Control Delay	23.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	190.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 1

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	247	2030	8	70	3163	208	393	253	365	185	572
v/c Ratio	0.89	0.65	0.01	0.34	0.85	0.82	0.85dr	0.74	0.99	0.98	1.05
Control Delay	122.8	16.8	4.1	99.1	38.0	109.5	76.1	86.0	134.7	150.3	109.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	122.8	16.8	4.1	99.1	38.0	109.5	76.1	86.0	134.7	150.3	109.6
Queue Length 50th (ft)	180	335	0	48	1029	309	244	348	282	286	~377
Queue Length 95th (ft)	#270	347	m1	80	1048	#454	320	475	#412	#491	#447
Internal Link Dist (ft)	508			1140		1285				1021	
Turn Bay Length (ft)	460	415	1000		280		370	385		500	
Base Capacity (vph)	278	3108	971	229	3733	261	535	341	368	188	544
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.65	0.01	0.31	0.85	0.80	0.73	0.74	0.99	0.98	1.05

Intersection Summary

- Volume exceeds capacity, queue is theoretical/infinite.
95th percentile volume exceeds capacity, queue may be longer.
m Queue shown is maximum after two cycles.
n Volume for 95th percentile queue is metered by upstream signal.
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 1

Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	444	444	444	444	444	444	444	444	444	444	444
Volume (vph)	247	2030	8	70	2837	326	239	109	506	487	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.86	0.91	0.86	0.91	0.91	0.91	0.88
Flt Protected	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00	0.95	1.00
Flt Permitted	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00	0.95	1.00
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	247	2030	8	70	2837	326	239	109	506	487	63
RTOR Reduction (vph)	0	0	3	0	9	0	0	69	7	0	0
Lane Group Flow (vph)	247	2030	5	70	3154	0	208	324	246	365	185
Turn Type	Prot	Perm	Prot	Perm	Prot	Split	pm+ov	Split	pm+ov	Split	pm+ov
Protected Phases	1	6	5	2	4	4	5	3	3	3	1
Permitted Phases											
Actuated Green, G (s)	13.0	124.4	124.4	8.5	119.9	29.1	29.1	37.6	20.0	20.0	33.0
Effective Green, g (s)	17.0	128.4	128.4	12.5	123.9	33.1	33.1	45.6	24.0	24.0	41.0
Actuated g/C Ratio	0.08	0.61	0.61	0.06	0.59	0.16	0.16	0.22	0.11	0.11	0.20
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	278	3109	968	204	3722	254	454	333	368	188	544
v/s Ratio Prot	0.07	0.40	0.02	c0.50	c0.13	0.11	0.04	0.11	0.11	0.11	c0.21
v/s Ratio Perm											
v/c Ratio	0.89	0.65	0.01	0.34	0.85	0.82	0.85dr	0.74	0.99	0.98	1.05
Uniform Delay, d1	95.6	26.4	15.9	94.8	35.3	85.6	83.9	76.6	92.9	92.8	84.5
Progression Factor	1.05	0.60	0.54	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.5	0.8	0.0	0.4	2.6	17.4	4.4	7.2	44.5	60.4	52.8
Delay (s)	120.5	16.5	8.7	95.2	37.9	102.9	88.3	83.8	137.4	153.2	137.3
Level of Service	F	B	A	F	D	F	F	F	F	F	F
Approach Delay (s)	27.7			38.1							
Approach LOS	C			D							
Intersection Summary											
HCM Average Control Delay	56.6										
HCM Volume to Capacity ratio	0.88										
Actuated Cycle Length (s)	210.0										
Intersection Capacity Utilization	87.3%										
Analysis Period (min)	15										
dr Defacto Right Lane. Recode with 1 though lane as a right lane.											
c Critical Lane Group											

Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	186	2966	102	334	1323	285	4	60	30	162	84	91
v/c Ratio	0.56	0.91	0.10	0.69	0.38	0.18	0.04	0.32	0.10	0.55	0.55	0.06
Control Delay	108.4	13.0	1.1	83.6	13.2	0.2	83.2	88.9	27.8	90.0	96.3	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	108.4	13.0	1.1	83.6	13.2	0.2	83.2	88.9	27.8	90.0	96.3	0.1
Queue Length 50th (ft)	120	889	6	179	221	0	5	42	15	108	112	0
Queue Length 85th (ft)	m124	#1191	m11	183	238	0	20	73	43	154	184	0
Internal Link Dist (ft)	508			1140			1285				1021	
Turn Bay Length (ft)	460	415	1000			290		119	218	398	322	168
Base Capacity (vph)	398	3253	1038	705	3479	1583				398	322	168
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.91	0.10	0.47	0.38	0.18	0.03	0.28	0.08	0.50	0.50	0.06

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	186	2966	102	334	1323	285	5	29	60	180	66	91
Volume (vph)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Ideal Flow (vphpl)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost time (s)	0.97	0.91	1.00	0.97	0.91	1.00	0.91	0.86	0.91	0.91	1.00	0.85
Lane Util Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.99	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	1610	2961	1441	3221	1677	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.99	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	1610	2961	1441	3221	1677	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	186	2966	102	334	1323	285	5	29	60	180	66	91
RTOR Reduction (vph)	0	0	26	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	186	2966	76	334	1323	285	4	60	20	162	84	91
Turn Type	Prot	1	6	5	2	Free	Split	4	4	5	8	8
Protected Phases	Permitted	6				Free						
Actuated Green, G (s)	14.5	117.6	117.6	23.0	126.1	190.0	8.2	8.2	31.2	13.2	13.2	190.0
Effective Green, g (s)	18.5	121.6	121.6	27.0	130.1	190.0	12.2	12.2	39.2	17.2	17.2	190.0
Actuated g/C Ratio	0.10	0.64	0.64	0.14	0.68	1.00	0.06	0.06	0.21	0.09	0.09	1.00
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lane Grp Cap (vph)	334	3254	1013	488	3482	1583	103	190	297	292	152	1583
v/c Ratio Prot	0.05	c0.58		c0.10	0.26		0.00	c0.02	0.01	c0.05	0.05	0.06
v/c Ratio Perm	0.56	0.91	0.08	0.68	0.38	0.18	0.04	0.32	0.07	0.55	0.55	0.06
Uniform Delay, d1	81.8	29.6	12.9	77.5	12.8	0.0	83.4	84.9	60.7	82.7	82.7	0.0
Progression Factor	1.30	0.33	0.19	0.99	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	2.1	0.1	3.2	0.3	0.2	0.1	0.3	0.0	1.3	2.5	0.1
Delay (s)	106.8	12.0	2.5	79.6	12.7	0.2	83.5	85.3	60.7	84.0	85.2	0.1
Level of Service	F	B	A	E	B	A	F	F	E	F	F	A
Approach Delay (s)	17.1			22.3			77.3			61.6		E
Approach LOS	B			C			E			E		E

Intersection Summary
HCM Average Control Delay 22.6 HCM Level of Service C
HCM Volume to Capacity ratio 0.80
Actuated Cycle Length (s) 190.0 Sum of lost time (s) 12.0
Intersection Capacity Utilization 88.0% ICU Level of Service E
Analysis Period (min) 15
c Critical Lane Group

Queues
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Volume (vph)	247	2030	8	70	2837	326	208	383	253	365	185	572
Volume Ratio	0.89	0.65	0.01	0.32	0.93	0.21	0.82	1.11	0.77	1.08	0.56	0.36
Control Delay	121.8	16.5	4.0	97.7	45.1	0.3	109.3	104.6	69.8	155.5	172.2	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	121.8	16.5	4.0	97.7	45.1	0.3	109.3	104.6	69.8	155.5	172.2	0.6
Queue Length 50th (ft)	180	334	0	48	1291	0	309	312	287	308	310	0
Queue Length 95th (ft)	#270	342	m1	80	1337	0	#454	#402	396	#436	#516	0
Internal Link Dist (ft)	508			1140			1295				1021	
Turn Bay Length (ft)	460	415	1000				290		370	385		
Base Capacity (vph)	278	3131	978	229	3046	1583	261	467	332	337	172	1583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.65	0.01	0.31	0.93	0.21	0.80	0.84	0.76	1.08	1.08	0.36

Intersection Summary
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 m Queue shown is maximum after two cycles.
 n Volume for 95th percentile queue is metered by upstream signal.
 dr Defacto Right Lane. Recode with 1 though lane as a right lane.

HCM Signalized Intersection Capacity Analysis
11: Waxpool Rd & Pacific Blvd.

Waxpool Pacific Intersection Modification
Proposed Option 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
Volume (vph)	247	2030	8	70	2837	326	208	383	253	365	185	572
Volume Ratio	0.89	0.65	0.01	0.32	0.93	0.21	0.82	1.11	0.77	1.08	0.56	0.36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.91	0.86	0.91	0.91	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	1.00	0.90	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	1610	2883	1441	3221	1641	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	1610	2883	1441	3221	1641	1583
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	247	2030	8	70	2837	326	208	383	253	365	185	572
RTOR Reduction (vph)	0	0	3	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	247	2030	5	70	2837	326	208	383	245	365	185	572
Turn Type	Prot	Perm	Prot	Perm	Prot	Free	Split	Split	pmov	Split	Split	Free
Protected Phases	1	6	5	2	4	4	5	8	8	8	8	8
Permitted Phases	13.0	125.3	125.3	9.5	121.8	210.0	28.2	28.2	38.7	18.0	18.0	210.0
Actuated Green, G (s)	17.0	129.3	129.3	13.5	125.8	210.0	33.2	33.2	46.7	22.0	22.0	210.0
Effective Green, g (s)	0.08	0.62	0.62	0.06	0.60	1.00	0.16	0.16	0.22	0.10	0.10	1.00
Actuated g/c Ratio	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Clearance Time (s)	2.0	3.0	3.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Vehicle Extension (s)	278	3131	975	221	3046	1583	255	456	320	337	172	1583
Lane Grp Cap (vph)	60.07	0.40	0.02	0.02	0.56	0.13	0.14	0.05	0.11	0.11	0.11	0.36
v/c Ratio Prot	0.89	0.65	0.01	0.32	0.93	0.21	0.82	1.11	0.77	1.08	1.08	0.36
v/c Ratio Perm	95.6	25.8	15.6	93.8	38.2	0.0	85.4	86.2	76.5	94.0	94.0	0.0
Uniform Delay, d1	1.03	0.60	0.55	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Progression Factor	20.5	0.8	0.0	0.3	6.6	0.3	17.1	14.9	9.5	73.0	90.2	0.6
Incremental Delay, d2	119.4	16.3	8.6	94.1	44.8	0.3	102.5	101.0	86.0	167.0	184.2	0.6
Delay (s)	F	B	A	F	D	A	F	F	F	F	F	A
Level of Service	27.4	C		41.4	D		96.9	F	F	F	F	F
Approach Delay (s)												
Approach LOS												

Intersection Summary
 HCM Average Control Delay
 HCM Volume to Capacity ratio
 Actuated Cycle Length (s)
 Intersection Capacity Utilization
 Analysis Period (min)
 dr Defacto Right Lane. Recode with 1 through lane as a right lane.
 c Critical Lane Group